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Department of
Veterans Affairs

Handbook of Hearing Aid Measurement
1989

Veterans Health Services
and Research Administration
Washington DC 20420

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HANDBOOK OF HEARING AID MEASUREMENT
1989

AUDIOLOGY AND SPEECH/LANGUAGE PATHOLOGY SERVICE
VA MEDICAL CENTER
WASHINGTON, D. C. 20422

CENTER FOR MANUFACTURING ENGINEERING
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by E. D. Burnett and T. Savoy 7

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I. INTRODUCTION

The procedure used by the VA in awarding contracts for specific hearing aid models is a complicated one. The commonly used "low bid" concept as a basis for awarding contracts is not appropriate for hearing aids since it would strongly influence the quality and sophistication of the instruments submitted. Therefore, a method was developed by VA which includes tests, analyses, and rankings of the performance of hearing aids for the purpose of providing some objective measures of quality upon which to base decisions for contract award. The hearing aids listed in this publication were submitted for evaluation in this program.

The VA invites manufacturers to participate in the agency's annual hearing aid testing program. This year 17 manufacturers submitted 56 models, approximately 15 percent of the more than 500 hearing aid models currently available in the United States and abroad.

The VA tests regular and special purpose hearing aids (compression, high-pass, CROS, BICROS, automatic signal processing, and headworn bone conduction) and regular instruments in alternate years. Regular models were tested in Contract Year 1988, and the ones selected were awarded two-year contracts. Special purpose aids were tested this year, and those selected will remain on contract for two years. All aids are tested for VA by the Center for Manufacturing Engineering at the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS), and the Biocommunications Laboratory at the Catholic University of America, according to VA specified procedures.

The raw test data from the NIST are statistically managed by the VA's Hearing Aid Program staff from the Audiology and Speech/Language Pathology Service, VA Medical Center, Washington, D.C. An Index of Characteristics score, a measure of overall performance of a hearing aid model relative to other models of the same type is computed for all regular hearing aid models and compression, BICROS, and automatic signal processing models in the special purpose category. Performance on a number of subtests including Harmonic Distortion, Equivalent Input Noise Level, Index of Effectiveness, Uniformity of Slope, and Product Uniformity contributes to the final score for each hearing aid model. An Index of Characteristics score is not computed for CROS and high-pass hearing aid models because several subtests are not included in these categories of hearing aids. Selection of hearing aid models for contract are made from among those models which:

1. had Index of Characteristics scores which were markedly better than other hearing aids in their category, and/or

2. were deemed clinically necessary to provide adequate hearing rehabilitation for hearing-impaired veterans without reference to their measurement results.

In the next section of this publication, hearing aids which score in the top 50 percent, together with those awarded a VA contract because they possess particular characteristics needed for special clinical problems, are marked with an asterisk. This is not to say that the remaining instruments are not of value. It simply means that they did not perform as well on our tests and/or that they did not have characteristics judged to be as appropriate for the veteran population as others. Additionally, the number of different manufacturers and models on contract is limited by administrative constraints in managing such a large program.

The electroacoustic procedures used at the NIST for measurement of hearing aid performance and resulting data are presented in Section III of this handbook.

VA does not test all hearing aids - only those submitted by manufacturers who want to participate in the VA program. Furthermore, manufacturers are limited to a specific number of models which they may submit, depending on VA requirements for each particular type. Some manufacturers do not participate at all in VA's program, and others submit only one or two of their models for consideration. VA lists should not be used as an absolute buying guide. Aids not listed should not automatically be considered inferior devices.

VA aid selections are for special purposes models for contract years 1989-90. New and improved hearing aids are developed each year and, as a result, the VA contract list varies from year to year.

Primarily, VA provides hearing aids only to veterans whose hearing disability is the result of military service. For further information these veterans should contact their nearest VA facility.

Other veterans and all nonveterans interested in hearing aids are advised to seek audiological consultation in their local communities.

There is no "best" hearing aid for all individuals. Aids that test well for one person may not test well for someone else. In addition, aids with certain special characteristics will not be appropriate for every type of hearing loss. It is important to note, therefore, that the hearing aid model that has the highest Index of Characteristics score may not be the best one for YOU. The VA examines each eligible veteran before issuing a hearing aid. Final decisions as to which specific model will be issued to a veteran are made by audiologists in VA Audiology Clinics. VA's general advice to a person with a hearing disability is to seek professional guidance in obtaining the aid best suited to the particular problem.

II. SUMMARY OF HEARING AID TEST PROGRAM FOR CONTRACT YEARS 1989-90

MANUFACTURER	MODEL	TYPE+	CATEGORY$	GAIN#	SSPL#	INDEX OF CHARACTERISTICS°
Audiotone 2422 W. Holly P.O. Box 2905 Phoenix, AZ 85062	A54SR	OE	High Pass	28.0	113.0	
	A2000/AKFP	OE	Compression	49.0	134.0	58.1
	A2000/BKHP	OE	Compression	43.0	127.0	52.4
	A2000/BKJP	OE	High Pass	39.0	124.0	
	MSP/A90	OE	ASP	42.0	122.0	65.3
Beltone Electronics Corp., 4201 W. Victoria St. Chicago, IL 60106	Jubilee V	OE	High Pass	32.0	116.0	
	Suprimo V	OE	Compression	40.0	127.0	95.7
Bernafon, Inc. 1125 Globe Ave. Mountainside,NJ 07092	*C2	OE	Compression	45.0	128.0	121.3
	C2H	OE	High Pass	33.0	124.0	
	*T86	OE	High Pass	38.0	125.0	
Bosch Starkey New York 136-2 Remington Blvd. Ronkonkoma, NY 11779	*Star33PPANR	OE	ASP	45.0	129.0	102.5
	Star33PPCTC	OE	High Pass	42.0	128.0	
Electone P.O. Box 910 Winter Park, FL 32790	AM34AGC	OE	Compression	41.0	125.0	70.0
Fidelity Starkey Florida 100 Park Centre Blvd. Miami, FL 33169	915H	OE	High Pass	35.0	122.0	
	F229	BG	Bone Conduction			

II. SUMMARY OF HEARING AID TEST PROGRAM FOR CONTRACT YEARS 1989-90

MANUFACTURER	MODEL	TYPE+	CATEGORY$	GAIN#	SSPL#	INDEX OF CHARACTERISTICS°
Maico Hearing Instruments, Inc., 7375 Bush Lake Rd. Minneapolis, MN 55435	*M224VF	OE	Compression	27.0	114.0	130.2
	*MC033VF	OE	Compression	39.0	126.0	146.7
	*MC034VF	OE	Compression	40.0	125.0	131.6
	*SP137VF	OE	ASP	41.0	123.0	121.4
	*SP335VF	OE	ASP	54.0	136.0	113.2
	*SP345VF	OE	ASP	52.0	134.0	104.1
Oticon Corporation 29 Schoolhouse Rd. P.O. Box 424 Somerset, NJ 08873	*E25P	OE	Compression	43.0	132.0	115.2
	*E30P	OE	ASP	47.0	131.0	108.1
	E39PL	OE	Compression	49.0	134.0	82.4
	*E40	OE	High Pass	21.0	110.0	
Philips Audionics Corporation 49 South Main St. Spring Valley, NY 10988	P47IH	OE	Compression	26.0	109.0	65.8
	P47I	OE	High Pass	26.0	112.0	
Phonic Ear, Inc. 250 Camino Alto Mill Valley, CA 94941	PE600CHD	OE	High Pass	43.0	128.0	
	*PE805CD2	OE	Compression	28.0	116.0	120.2
	*PE805SCD2	OE	Compression	40.0	125.0	124.6
	PE845PPC	OE	Compression	51.0	134.0	52.9
	*PE860PPC	OE	Compression	51.0	132.0	106.2
Qualitone 4931 West 35th St. Minneapolis, MN 55416	*CCED	OE	Compression	24.0	113.0	126.1
	DED	OE	High Pass	26.0	113.0	
Rexton, Inc. 2415 Xenium Lane Plymouth, MN 55441	M28CEH	OE	Compression	34.0	119.0	93.8
	Nova MasterPP	OE	Compression	50.0	131.0	97.4
	Selectra PP-6	OE	Compression	51.0	133.0	95.4

II. SUMMARY OF HEARING AID TEST PROGRAM FOR CONTRACT YEARS 1989-90

MANUFACTURER	MODEL	TYPE+	CATEGORY$	GAIN#	SSPL#	INDEX OF CHARACTERISTICS°
Siemens Hearing	268S	OE	High Pass	28.0	114.0	
Instruments, Inc.	284PPAGCI	OE	Compression	37.0	126.0	97.7
10 Corporate Place,S.	*284PPASP	OE	ASP	39.0	129.0	143.9
Piscataway, NJ 08854	*303ASP	OE	ASP	33.0	118.0	123.4
	*304PPAGCI	OE	Compression	29.0	114.0	108.6
Telex Communications	*340CLO	OE	CROS	22.0	108.0	
Inc., 9600 Aldrich	*350 BC	OE	BICROS	28.0	116.0	137.8
Ave., South	363CAI	OE	Compression	46.0	131.0	88.6
Minneapolis, MN 55420	*402BC	EG	BICROS	47.0	130.0	78.2
	*402CROS	EG	CROS	31.0	118.0	
Unitron Industries,	UE-10	OE	Compression	44.0	128.0	59.5
Inc., 3555 Walnut St.	UE-10H	OE	High Pass	44.0	131.0	
P.O. Box 5010	UM60-H	OE	High Pass	32.0	116.0	
Port Huron, MI 48061						
Viennatone	117	OE	ASP	52.0	136.0	55.1
Starkey Florida	119	OE	ASP	49.0	131.0	63.0
1000 Park Centre Blvd.	132	OE	High Pass	6.0	94.0	
Miami, FL 33169	*AN	EG	Bone Conduction			
Widex Hearing Aid	F8+T	OE	High Pass	37.0	125.0	
Company, Inc.	G6T	OE	Compression	33.0	117.0	86.6
35-53-24th St.						
Long Island City,NY						
11106						

II. SUMMARY OF HEARING AID TEST PROGRAM FOR CONTRACT YEARS 1989-90

KEY:

+ Type: (OE) over-the-ear; (EG) eyeglass.

$ Category: (ASP) - Automatic Signal Processing (includes automatic filtering and "noise blocking" hearing aids).

# Gain and Saturation Sound Pressure Levels (SSPL) are the mean figures for three samples of the model. Gain was computed for the BICROS, Compression, and ASP categories using the values of the bands of frequencies between 1000 and 2500 Hz. Gain was computed for the CROS and High Pass categories using the values of the bands of frequencies between 1600 and 2800 Hz.

° The Index of Characteristics is a measure of the total performance of the hearing aid model relative to all other models submitted within each category. The mean weighted scores of each model for the subtests of Harmonic Distortion, Equivalent Input Noise Level, Index of Effectiveness, Uniformity of Slope, and Product Uniformity are summed to provide the measure of total performance. It was not obtained for the CROS and High Pass categories since some of the measurements needed to compute the Index of Characteristics were not performed.

* Hearing aid models selected for Contract Years 1989/90 and/or those instruments scoring above the mean Index of Characteristics.

NIST HEARING AID TEST PROCEDURES AND TEST DATA

by E. D. Burnett and T. Savoy
National Institute of Standards and Technology

1. INTRODUCTION

The methods used by the NIST to measure the electroacoustic characteristics of "regular" and "special-purpose" hearing aids* for the Veterans Administration attempt to represent the performance of a hearing aid *in situ*. Some of the methods are similar to those described elsewhere [1,2], but are not identical because of the differences between free-field or constant input sound pressure level and *in-situ* testing. The methods and terminology described in [3] are directly relevant, and are used as far as possible. Some terminology is used from [1]. Analogous terms to those of [3] are coined when [1] or [3] do not offer appropriate definitions.

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*For purposes of this report, "regular" hearing aids refers to over-the-ear, eyeglass, and body-worn hearing aids which are intended for use with closed or vented earmolds and which have no signal processing capabilities. "Special-purpose" hearing aids refers to IROS, CROS, BICROS, automatic filtering, "noise blocking" and compression hearing aids.

2. LIST OF SYMBOLS

f	frequency
FFGFR	free-field gain-frequency response
L_h	hearing aid output level in ear simulator
L_i	free-field (input) level
L_l	level produced in free field by loudspeaker with a constant voltage input
L_s	unoccluded ear simulator output level
PGFR	pressure gain-frequency response
$PGFR_z$	pressure gain-frequency response as measured on a Zwislocki or other ear simulator described in [9], [10] and [11].
$PGFR_2$	pressure response as measured on a 2-cm^3 coupler
SIGFR	simulated insertion gain-frequency response
SPL	sound pressure level referred to 20 μPa
SSPL	saturation sound pressure level
SSPL90	saturation sound pressure level value obtained using the techniques of ANSI S3.22 [1]
SSPLn	saturation sound pressure level value obtained using a random-noise test signal, as described in this report
t	time
THD	total rms harmonic distortion, in percent

3. HEARING AID TEST CONDITIONS

3.1 Types of Response

There are at least four possible ways in which the acoustic response of a hearing aid can be defined and measured. These are:

3.1.1 Free-field gain-frequency response (FFGFR). The difference between the hearing aid output SPL and the free-field SPL with no hearing aid present shown as a function of frequency. The output SPL is usually measured in a coupler or ear simulator. The reference microphone which determines the input level is placed either at the position that was occupied by the hearing-aid microphone port or at some location that has an equivalent SPL. (All SPLs are determined from the output voltage of calibrated microphones.)

3.1.2 Pressure gain-frequency response (PGFR). The difference between the hearing-aid output SPL measured in a coupler or ear simulator and the SPL at the hearing-aid microphone [1], shown as a function of frequency. Since most modern hearing aids are small, this response will differ only slightly from the FFGFR. Also, because the SPL can be controlled by a reference microphone immediately adjacent to the hearing aid microphone, the requirements for the test chamber can be relaxed somewhat from those required for the determination of the FFGFR.

3.1.3 Simulated in-situ gain-frequency response (SISGFR). The difference between the SPL of the hearing aid output at the eardrum of a wearer and the SPL at a defined point (such as the center of the head) in a free field without the presence of the wearer and hearing aid is known as the in-situ gain-frequency response It is a function of frequency. For the purpose of making practical measurements, the definition is modified by substituting an anthropometric manikin for the human wearer and a microphone in an ear-like coupler for the eardrum. Under such conditions, the word "simulated" is added to the definition.

3.1.4 Simulated insertion gain-frequency response (SIGFR). The difference between the SPL at the eardrum of a user with a hearing aid in place and the SPL at the eardrum with no hearing aid in place [4] is known as the insertion gain-frequency response (IGFR). It is a function of frequency. This response has also been called the orthotelephonic response [5] or the etymotic response [6] or simply, the insertion response[8]. For practical measurements this response is modified by the use of a manikin as is done for the in-situ response. The word "simulated" is the added to the definition. The insertion gain-frequency response permits the direct determination of the increase in the SPL that the hearing aid furnishes the wearer. The intent for the measurement is that the SIGFR be a good predictor of the functional response on an average user.

3.2 Measurement of the SIGFR

By using a manikin [7,8] the SIGFR can be determined by comparing the SPL in an ear simulator with and without a hearing aid in place. The ear simulator used in described in [8]. The equivalent volume of this simulator at low frequencies is less than the equivalent volume of the widely-used 2-cm^3 coupler and the equivalent volume further decreases as frequency increases. A modified Zwislocki ear simulator [10,11] which meets the specifications of [9], is used in the manikin.

3.3 Comparison of the SIGFR and the PGFR

Although the PGFR does not directly indicate the increase in SPL to a hearing-aid, clinicians and others concerned with hearing aids have become accustomed to evaluating a hearing aid's performance on the basis of the PGFR$_2$. Therefore, it is worthwhile to list the factors which cause the SIGFR and the PGFR$_2$ to differ. Fig. 1 shows this difference for two over-the-ear hearing aids with forward-facing microphones.

3.3.1 Difference in the response of the occluded and unoccluded ear canal. Fig. 2 shows the frequency response obtained at the simulated eardrum for a constant free-field input level. This response shows, among other features, the fundamental resonance frequency of the open ear canal and concha at about 2500 to 3000 Hz [12]. This resonance does not occur when the ear canal is blocked with an earmold. The output of a hearing aid, whether tested in a free-field environment or on a manikin, is sealed to a coupler or ear simulator. It should be noted that the open ear canal resonance causes the SIGFR and the PGFR to be different not because the hearing-aid termination is different -- the coupler could be the same in both cases -- but because the reference point for the input signal when determining the SIGFR is an eardrum preceded by an unoccluded ear canal. The effect on the SIGFR is to cause a pronounced dip near the frequencies of 2500 to 3000 Hz. Many hearing aids (or their earhook) have a resonance peak in this region which can cause the SIGFR to be reasonably constant in the vicinity of these frequencies.

3.3.2 Difference in SPL between the ear-canal entrance and the hearing-aid microphone position. The SPL at the unoccluded (reference) ear will be affected by the diffraction of sound waves around the head, torso, and pinna, and by standing waves in the pinna [7]. The hearing-aid microphone will be at a different location in the diffraction pattern, and thus be exposed to a different SPL than the ear canal entrance. The variations of the relative SPL alongside the head of the manikin have been measured, albeit for a smaller pinna than is now used for the testing [13,14]. From these data the variation in the hearing aid output for various microphone locations can be determined. These variations will usually not exceed 5 dB for commonly used microphone positions, and are a function of both frequency and position.

For most hearing aids, the case has only a slight effect on the SPL at the hearing aid microphone during the measurement of the SIGFR. However, certain hearing aids place the microphone in such a position that the case and earhook, and pinna, form a shield which prevents wind from any direction from directly impinging on the microphone. The generation of wind noise is thereby reduced. The microphone position may be such that the microphone no longer directly detects the SPL at the surface of the head. For such hearing aids, the SIGFR may be sensitive to small perturbations in the placement of the hearing aid. In one example, slight repositioning of the hearing aid on the pinna produced changes of as much as 20 dB over a limited frequency range in the vicinity of 3000 Hz.

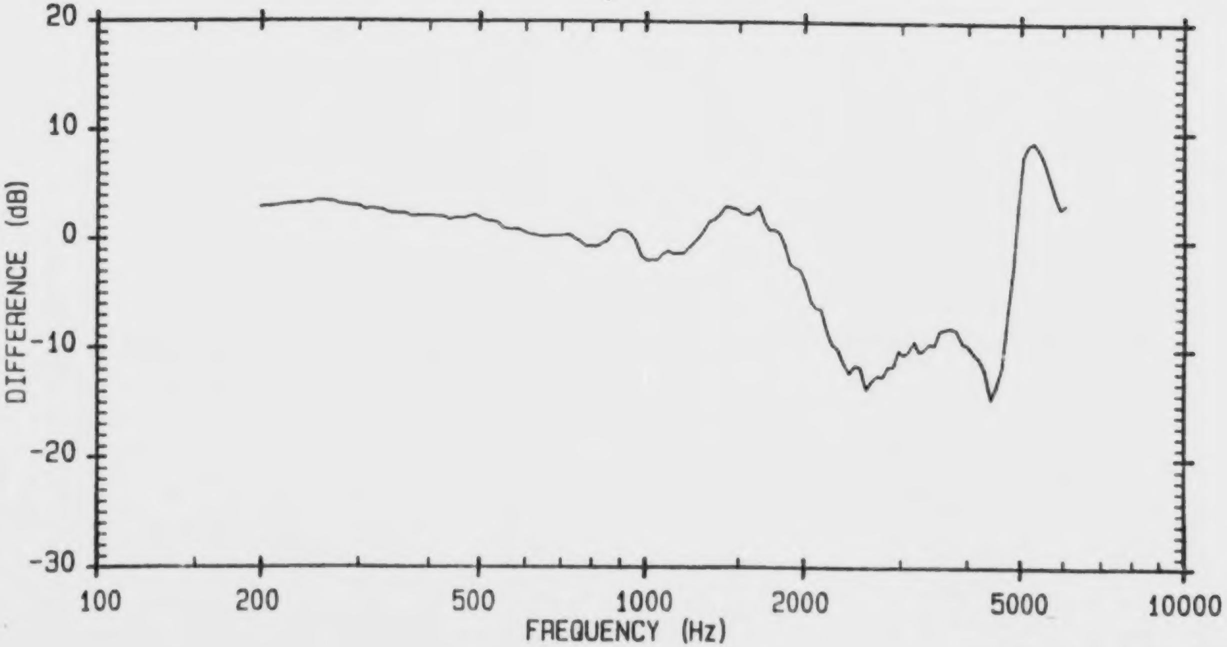

Figure 1. Average difference between the insertion response using an ear simulator and the pressure response using a 2-cm^3 coupler for two hearing aids with forward-facing microphones.

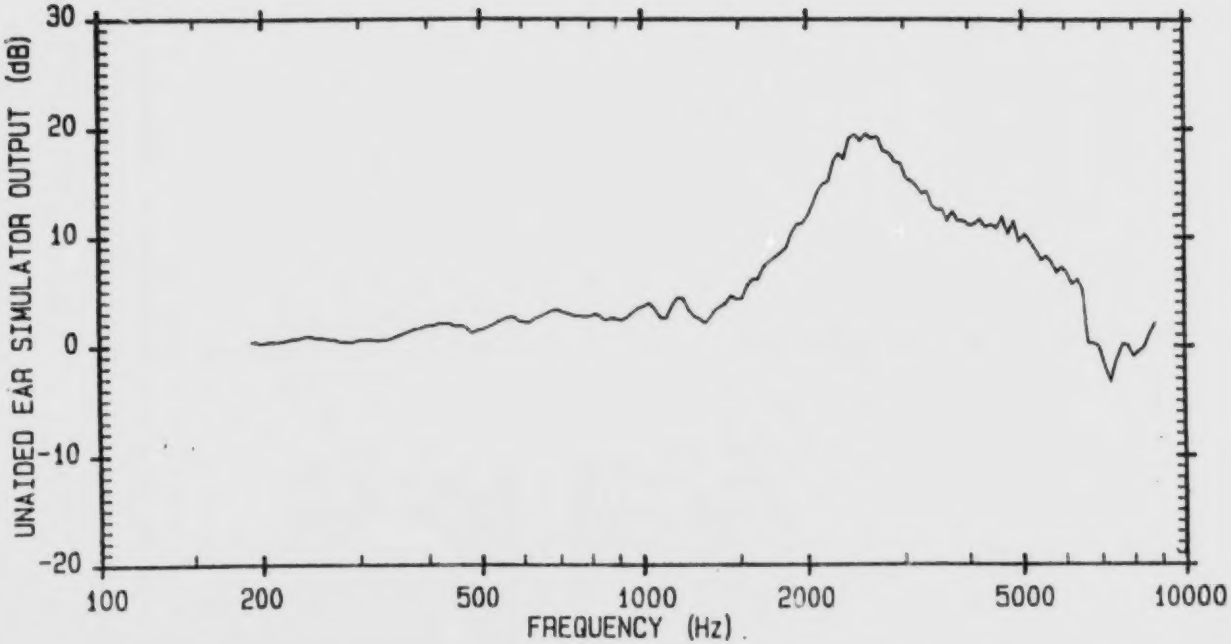

Figure 2. Frequency response of the unoccluded, right ear coupler with large pinna in the manikin.

3.3.3 Differences in coupling between the hearing aid and the coupler or ear simulator. Couplings used with the 2-cm^3 coupler are described in [1] and [15]. The couplings used when determining the SIGFR are described in section 3.5 of this report. Differences of length in the coupling will produce different resonance frequencies and different absolute levels. A complete evaluation of these differences is beyond the scope of this discussion.

3.3.4 The difference in the characteristics of the 2-cm^3 coupler and the Zwislocki ear simulator. The SIGFR is measured using a simulator such as the modified Zwislocki [9,10,11]. PGFR measurements are customarily measured using a 2-cm^3 coupler [1,15]. As shown in [10], for an earphone with a constant volume displacement the difference between the pressures measured on the coupler and simulator is not invariant, but will depend upon the acoustic impedances of the driving earphone and coupling system. This difference is usually such that it partially compensates for other differences between the SIGFR and the PGFR in the high frequency region. For this reason, the PGFR of a hearing aid, when measured using a 2-cm^3 coupler, will more nearly correspond to the increase in SPL that a hearing aid provides a user than would a PGFR measured on a Zwislocki ear simulator. Although both measurements overestimate the help that a hearing aid furnishes above 1 kHz, the PGFR_2 does so by a larger amount than does the PGFR_z.

3.4 Measuring Methods

Several methods for determining the SIGFR have been described by Burnett [16]. In order to choose among these methods, we first consider several significant constraints on the procedures:

1. Since hearing aids are non-linear devices, it is convenient that the free-field (input) SPL be uniform with frequency so that a well-defined set of test conditions exists.

2. The same ear simulator should be used for determining the SPL of both the aided and unaided signal at the coupler microphone. Problems due to lack of symmetry in the manikin design, or the acoustic field, are thereby avoided.

3. An active reference microphone may give problems because some hearing aids will radiate into the surrounding space and thus change the level produced by the loudspeaker. Rather, the free-field level should be determined at some time prior to the determination of the hearing-aid output level.

These constraints require the use of instrumentation with considerable data storage capability. A computer controlled data processing system offers this with convenience and accuracy. The major instrumentation components of this system are an Hewlett-Packard 3562A signal analyzer, and two Bruel and Kjaer 2636 measuring amplifiers.* The computer system used may be one of several types within the Hewlett-Packard 9000 series.

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*Instruments are identified only to specify the test apparatus and procedures. The listing of an instrument should not be interpreted to imply that it is the best or the only device available for its intended purpose.

We will describe the methods by first considering the most elementary form of the equation for SIGFR,

$$\mathrm{SIGFR} = L_h - L_s. \qquad (1)$$

That is, the simulated insertion response is the SPL developed at the ear simulator microphone with the hearing aid in place less the SPL with no hearing aid in place.

Next, recognizing that the hearing aid and unoccluded ear simulator output levels are functions of frequency, input level and, to some extent, time, we write more exactly,

$$\mathrm{SIGFR} = L_h(f,t,L_i) - L_s(f,t,L_i). \qquad (2)$$

The level, L_s , is a linear function of L_i. The level, L_h, can be, and usually is, a non-linear function of L_i. However, if the hearing aid is operated below the saturation level, and if it does not employ compression circuitry, the functional relationship is such that linearity can be assumed for small changes in L_i, say on the order of ±2 dB. The significance of this fact is that small departures from the desired input SPL can occur without affecting the accuracy of the measurement of the SIGFR, provided that the input SPL is the same when measuring both L_h and L_s.

It has long been recognized that frequency response measuring techniques using sinusoidal input signals do not always predict accurately the performance of a hearing aid when real-life signals, especially speech, are applied. This is particularly so for hearing aids with AGC, or which have any type of automatic filtering. Beginning with the current measurement year, random-noise signals are being used to characterize the frequency response. Therefore, the SIGFR is determined by two different methods.

3.4.1 Sinusoidal sweep frequency response. The first method uses a traditional sinusoidal sweep technique, and is applied for one of three hearing aids for each model, in order to determine the correlation with the results of the second method, which uses the random noise input signal. This first method consists of the following steps.

1. The free-field response of the loudspeaker is obtained. A "half-inch" microphone having a nominally flat pressure response is placed in the test chamber at the reference test position of the manikin, with the manikin removed. The microphone is oriented at grazing incidence, i.e. the plane of the microphone diaphragm is perpendicular to the plane containing the front surface of the loudspeaker. At this orientation, the microphone has an essentially flat free-field response in the frequency range of interest. The microphone output is connected to the input of a B and K 2636 Measuring amplifier, whose output in turn is connected to the input of channel 2 of the signal analyzer. The output SPL of the microphone, as passed through this chain, is measured using the swept-sine mode of the signal analyzer. The associated computer system determines the range setting of the measuring amplifier, and adjusts the Engineering Unit calibration of the analyzer accordingly. The sweep has thirty steps in frequency per octave, and is made using a constant drive voltage from the source of the analyzer. The drive voltage is chosen so that the measured sound pressure levels are about 70 dB in order to minimize the effects of any spurious noise in the system. The readings of the analyzer (as SPL) are stored in a computer file as $L_i(f)$.

2. The file of the levels, $L_i(f)$, is used to control the drive levels to the loudspeaker. The voltage level from the analyzer source is set to the quantity $K_{60}-L_i(f)$. The constant, K_{60}, is chosen so that the controlled output level of the loudspeaker is equal to the desired input level, L_i, of 60 dB. When this procedure is done shortly after that of step 1, the output level of the loudspeaker will be constant with frequency within±0.2 dB.

3. The output levels from the ear simulator microphone are obtained at a time called t_a. The manikin is placed in the test chamber and the microphone which was used in step 1 is placed in the ear simulator of the manikin. Procedures similar to those of step 1, but using the input level of 60 dB which was obtained in step 2, are used to obtain a computer file containing the readings of the ear simulator levels, stored as $L_s(f,t_a,60)$.

4. Next, the hearing aid to be tested is placed on the manikin at the time t_b. It is coupled to the ear simulator. Procedures similar to those of step 3 are used to obtain a computer file with the readings of level stored as file $L_h(f,t_b,60)$.

5. Then, the SIGFR (equation 2) is determined by subtracting the levels obtained in step 3 from the levels of the corresponding frequencies in step 4.

In order for the SIGFR to be determined accurately, the essential characteristics of the measurement system at the times t_a and t_b must be the same, within the desired limits of accuracy. Any changes which do occur can be attributed almost entirely to changes in the loudspeaker sensitivity, provided care is taken that the manikin position is not disturbed. Apparent changes in the loudspeaker sensitivity do not necessarily mean that some change has occurred in the loudspeaker. The differences may be due to changes in the ambient conditions, e.g. barometric pressure. Whatever the reason, new records of the ear simulator output must be obtained at intervals frequent enough that the error does not become too large. The error is checked by running a frequency response of the open ear simulator and determining the SIGFR as if a hearing aid were in place. The value of the level of this pseudo SIGFR of the unaided ear should be, of course, zero decibels at all frequencies. If the absolute value of this response level becomes more than one decibel at any single frequency, or the average value in any one of the 20 bands of equal speech intelligibility (Sec. 4.2.5) becomes more than 0.5 dB, a new record is obtained for the open ear-simulator output. Unless a large change occurs on a given day for the barometric pressure, this is done approximately every week.

Notice that the accuracy of insertion responses measurements does not depend upon the input level remaining constant. The level must, of course, not change so much that the assumption of linearity in the hearing aid is invalidated. The value of the input level is assumed to be adequately controlled if it remains within ±2 dB of a level of 60 dB. In practice, the input will remain within this tolerance over a period of many months. To measure the input level directly, the manikin must be removed from the chamber and the microphone removed from the ear simulator, as discussed in step 1, above. Because of the stress exerted upon the microphone diaphragm when inserting it in the simulator it is desirable to do this as infrequently as possible. Some idea of the changes in the input level over a period of time can be obtained, even if the actual values of the input level are not recorded. This is done by examining the changes in the values of the ear simulator output levels obtained in step 3 over the time period in question.

3.4.2 Random noise frequency response. The second method for determining the SIGFR employs a random noise input signal and the frequency-response mode of the signal analyzer. The signal is produced by the noise source of the analyzer. The noise is passed through a network which produces a signal whose idealized power spectrum is shown in Fig. 3. Below 200 Hz the spectrum is rolled off steeply. The exact rate of roll-off is not critical since the corner frequency is outside the frequency limit of most hearing aids and, in any case, the signal does not contribute appreciably to the overall output SPL after it has rolled off several decibels. High frequencies are attenuated by a single RC network, having a 3 dB point at 900 Hz.

The measurement is done in five steps, analogous to those used for the swept-sine determination.

1. The frequency response of the loudspeaker is obtained, and is equalized to be as flat as possible. The equalizer used was custom-built, but a commercial one/third octave filter set normally used for the equalization of sound-reinforcement systems or home music systems could be used. The frequency response mode of the 3562A analyzer is used for in this analysis. The input to channel 1 of the analyzer comes from its own internal noise source, and the input to channel 2 is the output of a "half-inch" microphone, placed as in step 1 of the swept-sine SIGFR determination. After equalization, the measured loudspeaker frequency response is then flat within ± 1.5 dB of the desired spectrum. Then the filters which produce the speech weighting are inserted in the circuit. With this filter system in place, the frequency response is again determined.

2. The level of the speech-weighted signal is determined by the measuring amplifier, and the drive level which produces 60 dB is noted.

3. The frequency response from the output of the frequency weighting network to the ear simulator output is obtained at an input level of 60 dB. The manikin is placed in the chamber and the microphone used in step 1 is placed in the ear simulator of the manikin. This frequency response is stored internally in the analyzer and also as a computer file.

4. Next, the hearing aid is placed on the manikin, and coupled to the ear simulator. Procedures similar to those of step 3 are used to obtain a record of the frequency response.

5. Then the SIGFR is determined by dividing the complex frequency response from step 4 by the complex frequency response from step 3. This division is done by the signal analyzer. The resultant SIGFR is stored as a computer file.

Those constraints on accuracy which are related to time are similar to those for the sinusoidal frequency response. In addition, the coherence function of the hearing aid frequency response is obtained, and the number of samples required for an accurate measurement is determined. At least 25 samples are taken, and the number may be as high as 250.

3.5 Coupling to the Ear Simulator

Hearing aids are used with a closed mold which is intended to make a good seal in the ear to minimize feedback, or with an earmold which is vented or otherwise opened. This is done to modify the frequency response of the hearing aid or to permit direct sound to pass directly to the ear canal.

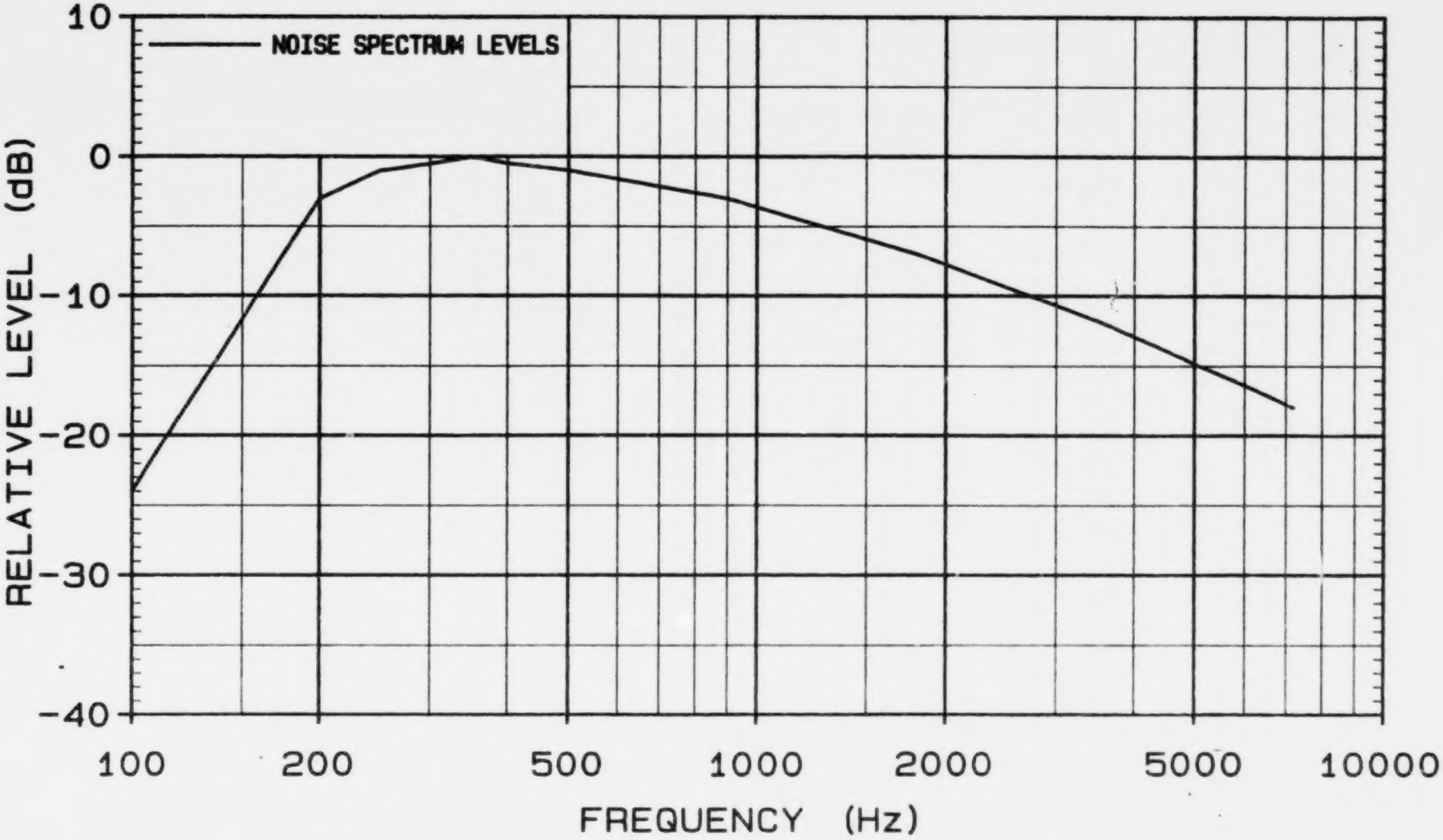

Figure 3. The idealized power spectrum level of the NIST random noise test signal after filtering.

For the measurement of each closed-mold fitting, head-worn, hearing aid, an adaptor 8.6 mm long with an internal diameter of 3 mm is slipped into the outer portion of the Zwislocki coupler [18]. A section of No. 13 tubing, which an internal diameter of 1.93 mm, is coupled to this adaptor and fitted to the hearing aid's earhook. The length of this tubing depends on the geometry of the hearing aid. For most over-the-ear hearing aids, the length of the tubing is 31 mm external to the adaptor with 2 mm of this length being slipped over the earhook. (The tube is actually about 34 mm in length, with 3 mm being slipped over the adaptor nub.) For eyeglass hearing aids, the tubing lengths were increased by 1 to 3 mm, as needed to fit. (Tubing lengths have been increased by as much as 9 mm when required, but such large increases were not needed this year.) The internal tubing diameter is that specified in [1]. The tubing lengths were chosen to give a good fit of the hearing aids on the head. The use of an adaptor with an internal diameter of 3 mm conforms to the types of earmolds which are believed to be the most commonly used within the VA system.

Hearing aids for open-mold fittings (high frequency and CROS-type hearing aids) are tested using a very open earmold, sometimes called a "phantom" earmold. A 32-mm length of tubing (42 mm for eyeglass type hearing aids) is used for coupling to the hearing aid. 12 mm of this length protrudes through the earmold, terminating at the outer end of the metal manikin adaptor which is attached to the Zwislocki coupler.

For the measurement of body-worn hearing aids, an adaptor 18 mm long with an internal diameter of 3 mm is placed on the ear simulator [18]. In order to use this adaptor, the ear simulator must be removed from the manikin's head. The assembly is then placed at a convenient position, usually behind the manikin's torso.

When using any type of ear simulator with a closed mold, reasonable efforts are made to obtain good acoustical seals and to otherwise minimize feedback problems. (This is the reason that the simulator is placed behind the manikin when testing body-worn hearing aids, thus taking advantage of the body shadow of the manikin.) Such practices may not mimic actual usage. However, the temporally-varying leaks which occur when hearing aids are used on the human head could not be reproduced in a standardized testing system. Despite the need for good seals, petroleum jelly or other sealing material may not be used in the vicinity of the ear simulator. It would change the acoustic impedance of materials used in that device.

3.6 Acoustic Environment

The manikin is placed in a small, approximately cubical, anechoic chamber having a volume inside the wedge tips of 10.4 m^3. The sound source is an "8-inch" loudspeaker placed in an enclosure which is filled with fiberglass and has an internal volume of .042 m^3. The front surface of the enclosure is covered with sound absorbent material to reduce the amplitude of standing waves patterns developed between the enclosure and the manikin and to reduce effects due to diffraction at the edges of the enclosure.

3.7 Manikin Configuration and Position

The manikin described in [7] is used with one of its neck rings in place. In order to obtain reproducible results no clothing or wig is used. The pinna is the larger of the two sizes available for the manikin. Whenever possible, measurements are made using the pinna and ear simulator on the right side of the head.

The reference point of the manikin is defined as the point in the center of the head, on a line connecting the ear canal axes. The manikin is positioned so that the reference point is on the axis of the loudspeaker cone 1 m from the front surface of the loudspeaker enclosure.

4. MEASUREMENTS PERFORMED ON "REGULAR" HEARING AIDS

4.1 Measurements with Volume Control at Maximum Setting

The maximum setting of the volume control normally occurs with the control turned "full on." Occasionally feedback occurs at this gain setting in spite of all precautions, and the volume control must be reduced to eliminate the feedback. This physically reduced setting becomes the maximum setting. A notation is made in the report when this occurs.

4.1.1 Saturation Sound Pressure Level (SSPL). The saturation sound pressure level is the maximum rms SPL that can be obtained in the ear simulator from the hearing-aid output when the input sound has a specified spectrum and is varied over the range from 60 to 90 dB.

The SSPL is determined by using the speech-weighted, random-noise signal discussed in Section 3.4.2.

ANSI S3.22 [1] defines a method for determining the SSPL which requires applying a sinusoidal input signal at a level of 90 dB. The resultant determined value of the SSPL is called the SSPL90. The NIST uses a different method which gives a true value for the SSPL even when it occurs for an input level below 90 dB, and which also gives information about the input level required to saturate the hearing-aid output. The speech-weighted random-noise signal is applied at a free-field SPL of 90 dB. Then, the input level is reduced in 2 dB decrements until the output level is 1 dB below the maximum level, whether that maximum level occurred with an input SPL of 90 dB, or with some lower level. Recording the input level which produces an output level 1 dB below the maximum solves the problem of accurately determining the input level as the output asymptotically approachs the maximum. The actual SSPL is recorded subject only to the constraint of the maximum input level of 90 dB. The SSPL which is measured using this technique is called SSPLn in this report.

The desired reference input SPL for the measurement is the SPL which exists in the free field with no manikin in place. However, it is not feasible to remove the manikin to measure this SPL as each hearing aid is measured. Therefore, the difference in the SPL between the free field and the otherwise unused left ear simulator of the manikin is determined. This difference is subtracted from the ear-simulator output to arrive at the free-field SPL. The value of the difference is a critical function of the spectrum of the random noise, since the ear simulator weights various frequencies differently by more than 20 dB. The values obtained for the difference have varied from 7 to 10 dB, with the smaller value being observed with a smaller pinna which was used until 1981.

Users of the SSPLn data may wish to make comparisons with data obtained using the techniques for measuring the SSPL90 described in [1]. The factors influencing the frequency response described in sections 3.3.3 and 3.3.4 will also affect the SSPL. The fact that noise is used instead of consecutive sinusoidal signals also produces different results. A precise value for the difference using the two methods cannot be given *a priori* for a particular hearing aid, but will usually be between 3 and 5 dB.

4.1.2 One-kilohertz gain. The insertion gain of the hearing aid is measured with a free-field input SPL of 60 dB. Although the Veterans Administration discloses these data, this gain figure is not used in arriving at their "index of characteristics".

4.1.3 Telephone pickup coil. The hearing aid is placed on the manikin in the test chamber as described in Section 3.6. The output of the ear simulator is measured with the telephone pickup coil actuated at the pure-tone frequencies of 500, 1000, 1600 and 2500 Hz. The magnetic field strength is 10 mA/m. Measurements are made with the field vertically oriented, i.e., the magnetic field lines are perpendicular to the floor of the test chamber, with the field laterally oriented, i.e., the magnetic field lines are parallel to the ear canal axis, and with the field longitudinally oriented. i.e. the magnetic field lines run from the front to the back of the head. The output SPL reported is the average for the frequencies of 1000, 1600 and 2500 Hz. The noise floor is also reported. It is the output level with no input signal present, and is a combination of the inherent hearing aid noise and the ambient field. Also shown is the calculated maximum output level. It is the root sum square, converted to level, of the output amplitudes with the field in the three orthogonal directions. Assuming linearity, it shows the output which would have been obtained with the field oriented for the maximum output.

4.2 Measurements with Volume Control at Reduced Setting

The position of the volume control setting is determined using the noise spectrum described in section 4.1.1. After the determination of the SSPLn, the input level is reduced to 60 dB. The volume control is adjusted so that the value of the SPL in the ear simulator is 17 dB below the value of the SSPLn. If the hearing aid, with an input SPL of 60 dB, does not have enough gain to achieve a level 17 dB below the SSPLn, the volume control is kept at the "full-on" setting. This condition rarely occurs, however. The amount of volume control reduction required is more sensitive to the shape of the noise spectrum than is the value of the SSPL. Consequently, to perform this test, the equalization correction for the loudspeaker frequency response is especially important.

4.2.1 One-kilohertz gain. The insertion gain of the hearing aid is measured in the same manner as for "full-on" gain (Sec 4.1.2). The level difference between the "full-on" gain and the reduced gain is an indication of the amount of the volume control reduction.

4.2.2 Total harmonic distortion (THD). The ratio of the rms amplitude of harmonic components to the fundamental rms amplitude multiplied by 100 defines the percent THD.

The THD measurements are made using test tones of 500, 800 and 1600 Hz, at a free-field input level of 70 dB. In addition, the maximum THD which occurs between 800 and 2500 Hz is measured, as is the frequency at which it occurs. The THD values at these frequencies enter into the "index of characteristics" arrived at by the Veterans Administration. Also, the distortion is determined at additional frequencies over the frequency range of 500 to 2500 Hz so that a plot of the percent THD v. frequency can be presented on a graph with the SIGFR.

4.2.3 Equivalent input noise level. The self noise produced by a hearing aid is specified as an equivalent input noise level. The method used is similar to that of [1]. However, the hearing aid is coupled to the ear simulator on the manikin. The output SPL of the hearing aid is determined at 1000, 1600 and 2500 Hz, using a free-field input level of 60 dB at each frequency. From these measurements, the average gain for the three frequencies is determined. (Note that the correction for the insertion gain is not appropriate for this measurement, since the actual differences in output levels with and without an input signal present is of interest.) The average gain is subtracted from the output noise level which exists with no signal present. This subtraction determines the value of the equivalent input noise level.

4.2.4 Battery Drain. Normally, a mercury cell is used for this test. An alkaline type is used for size AA cells used with body-worn hearing aids. Mercury cells are first partially discharged by placing a dummy load across them until the voltage is reduced to 1.34 or 1.35 V. (Multi-cell batteries are rarely used in hearing aids. In this discussion it will be assumed that all hearing aid "batteries" are actually single cells.) A cell will be used for at least the three hearing aids of one model. It may be used for more than one model, but will be discarded when the voltage drops below 1.30 V.

When the current drain is measured, the cell is placed in an external holder that has leads attached to the battery terminals of the hearing aid. The current drain is measured twice, first with no incident sound on the hearing aid and then again with an incident random-noise signal having the spectrum shown in Fig. 3 and a free-field SPL of 64 dB. The battery voltage is measured once, with no incident sound present.

4.2.5 Frequency response. The insertion frequency response is obtained with a random noise input signal as described in Section 3.4.2. The frequency responses of the three hearing aids tested for each model are then plotted on one graph with a full scale range which is normally 50 dB. Occasionally a greater range is used if required by the results. The frequency response is displayed from 200 to 7000 Hz.

The average insertion gain for each of 20 bands of equal speech intelligibility is calculated as the frequency response is obtained. These average values appear with the tabulated data for each model.

5. MEASUREMENTS PERFORMED ON "SPECIAL PURPOSE" HEARING AIDS

5.1 BICROS hearing aids

Hearing aids of this class are tested on the manikin using the closed-mold coupling described in Section 3.5. The tests performed are those described for "standard" hearing aids in Sections 4.1 and 4.2. Some BICROS hearing aids have a separate volume control for each of the two microphones. The controls are adjusted so that each microphone makes an equal contribution to the output. One microphone is completely turned off, and the gain for the second microphone is adjusted so that the output level is 6 dB below the desired level. Then the gain for the first microphone is adjusted so that the output is at the proper level.

5.2 CROS hearing aids

Hearing aids of this class are tested on the manikin using the open-mold coupling described in Section 3.5. The methods used are those described in Sections 4.1 and 4.2, except that total harmonic distortion measurements are not made. Even with the open mold coupling, the head shadow usually gives enough attenuation so that feedback does not occur. Occasionally, there is some feedback which requires that the gain be reduced slightly before measuring the SSPLn.

5.3 High Frequency Emphasis hearing aids

Hearing aids of this type are commonly used with earmolds which have various degrees of venting, ranging from slight amounts to completely open molds. Therefore, we test these hearing aids for two extreme earmold conditions. The first set of measurements is made with a closed earmold adaptor using the tests described in Sections 4.1 and 4.2 with several exceptions. Harmonic distortion tests are not made, and the equivalent input noise level and the telephone coil sensitivity are based on measurements made at 1600 and 2500 Hz. The second set of measurements involves the determination of the insertion response on the open-mold ear simulator. When the hearing aid is tested with an open ear mold, a special criterion must be used for setting the gain. The open mold allows some part of the acoustical output signal to feed back to the microphone so that the hearing aid will feed back if the loop gain exceeds unity at a frequency for which the phase shift is an integral multiple of 360 degrees. This oscillation usually occurs at a frequency higher than 2000 Hz, and its occurrence determines the maximum gain setting that can be used. To test the hearing aid, the gain control is first adjusted to the highest possible gain setting for which oscillation does not occur with no input signal present. Then, using an input frequency of 1600 Hz, the gain is reduced 5 dB. This gain setting is used for determining the open ear-mold insertion response.

5.4 Compression hearing aids

Hearing aids of this type are first tested using the methods described in Sections 4.1 and 4.2. Then, several additional tests are done in order to characterize their performance.

5.4.1 Attack and release times. The method described in [1] for determining the attack and release times is used. The hearing-aid volume control is set to the "full-on" position and the input SPL is varied between 55 and 80 dB. (For this test only, the input SPL is determined at the hearing-aid microphone position.) A signal frequency of 2000 Hz is used. Usually, a duration of milliseconds is used for the high-level portion of the signal and a duration of 1 second is used for the low-level portion of the signal. Longer times may be used if needed for steady-state conditions to be reached. It is recognized that this signal is not sufficient to characterize the performance of "dual-time constant" hearing aids which are now being manufactured.

The output signal is processed by a digital signal analyzer, which for this test displays the level of the envelope of the hearing aid output signal. The cursors available on the analyzer are used to determine the time from onset of the high and low level portions of the signal to the time when the signal is within 2 dB of its final value. The display is then recorded on a digital X-Y plotter.

5.4.2 Output level vs. input level. A set of data is taken in which the input is varied in level from 50 to 90 dB. This is done for frequencies of 500, 1000 and 2000 Hz. Two gain settings are used, the "full-on" gain and the reduced setting determined in Section 4.2. The family of input-output curves which results is plotted, and the 2-dB knee point, as defined in (1), is noted on each curve. If the knee points remain at approximately the same input level for the curves for the two gain settings, the compression is determined to be input dependent. If the knee points remain at approximately the same output level for the curves for the two gain settings, the compression is determined to be output dependent.

* * *

5.5 Automatic filtering hearing aids.

These hearing aids are designed to change the shape of their frequency response as the input level changes. Typically, but not necessarily, the response change will be a reduction in the low-frequency output of the hearing aid as the input level is increased through the region of 60 to 70 dB.

To test these instruments, the tests for standard hearing aids are first done. Then, in order to show the signal processing effect, random noise frequency responses are obtained using techniques similar to those of section 3.4.2, but for input levels of 50 to 80 dB with 10 dB increments. In some cases, an input level of 65 dB was also used. When presenting the data, the input level is added to the gain so the effective difference between output SPLs can readily be seen.

5.6 "Noise Blocking" hearing aids.

This class of hearing aids is designed to discriminate between speech and noise signals, and to reduce the hearing aid gain at high and/or low frequencies, depending on the spectrum of the noise. In the presence of low-frequency noise, the gain is reduced below about 1500 Hz. In the presence of high-frequency noise, the gain is reduced above the same frequency.

To test these aids, the noise filtering is first switched off, and the tests for standard hearing aids are done. Then, the noise filtering is switched on, and additional tests using speech itself as a test signal are run. The speech signal is taken from a compact disc, issued as an auditory demonstration disc by the Acoustical Society of America [19]. The section used is not one of the auditory demonstrations per se, but is the commentary for demonstration 9 on track 22. This commentary lasts for 30 seconds, and has desirable characteristics (uniform level and appropriate long term spectrum) for this use. The signal analyzer is triggered by the speech signal so that analyses are made only when the signal is present. 50 samples are analyzed during the 30 second interval. The test setup is similar to that used in section 3.4.2, except that the noise source is replaced by the compact disc player when obtaining the frequency response with the hearing aid in place. Frequency responses are run with speech input levels of 50 and 60 dB. Then, either low or high frequency noise is mixed with the speech signal. The low-frequency noise is band-pass filtered from 400 to 800 Hz, at levels of 50 to 75 dB. The high-frequency noise is band-pass filtered from 3000 to 3400 Hz, at levels of 40 to 60 dB. Not all levels were used for each hearing aid, but only that range which demonstrated the action of each instrument.

6. TEST RESULTS

The test results are given in the appendix.

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AUDIOTONE - A-54SR **HP**

SETTINGS - KNEE:60 TONE:H
BATTERY - 675

NBS CODE	AT484	AT485	AT486
SERIAL NO.	8A0010	8A0027	8A0047
DATE TESTED	6/15/88	6/15/88	6/15/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	13	11	10.5
SSPL for shaped noise signal (dB)	114.5	113.5	111.5
with input spl (dB)	78	80	80
Induction coil output level (dB)			
Self noise	70.5	67	64.5
Vertical field= 10 mA/m	94	93	93
Lateral field= 10 mA/m	72	74.5	76.5
Longitud field= 10 mA/m	87.5	82.5	87
Calculated maximum	95	93.5	94.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	7.5	6.5	5.5
Equivalent input noise level (dB)	29	30	28.5
Battery drain (mA)			
No input signal	1.1	1.3	1.3
With shaped input noise level=65dB	1.1	1.3	1.3
Battery voltage (V)	1.32	1.32	1.32

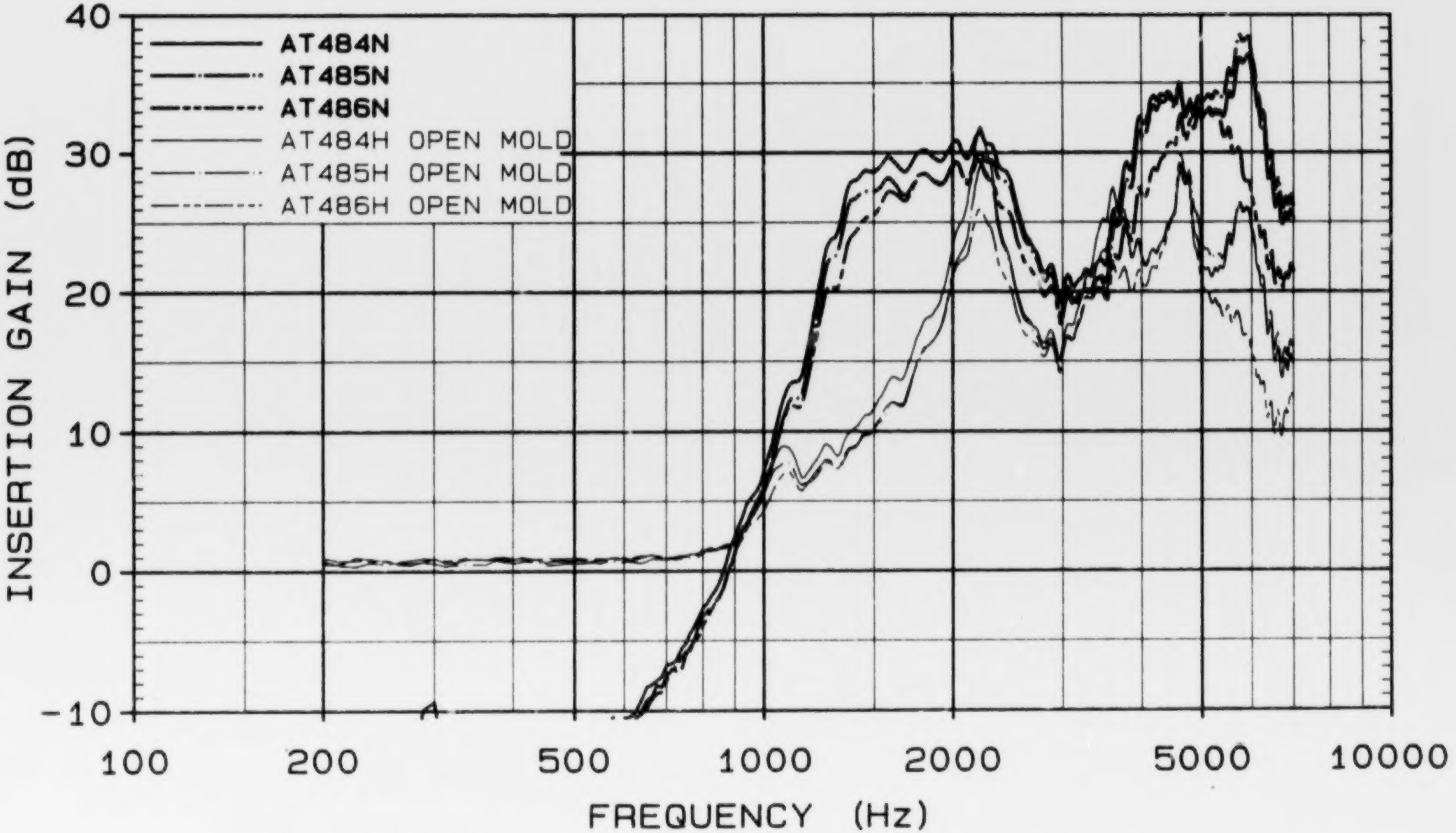
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
AT484	-13.5	-13	-11.5	-9.5	-4	3.5	11.5	20	27.5	29
AT485	-14	-14	-12	-10	-5	2	10	18.5	26	27.5
AT486	-14	-14	-12.5	-10.5	-5	2	10	17	23.5	26.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
AT484	29.5	30	30.5	29.5	24	21	22.5	31	33.5	34.5
AT485	28	28	29	28.5	23.5	20	21.5	30	33.5	36
AT486	27.5	28.5	28.5	27	22	19.5	20.5	26	31.5	31

edb edb edb

AUDIOTONE - A-54SR



AUDIOTONE - A-90 **AF**

SETTINGS - THR:65 SP:ON
BATTERY - 675

NBS CODE	AT487	AT488	AT489
SERIAL NO.	8A00053	8A00143	8A00155
DATE TESTED	6/28/88	6/29/88	6/29/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	49.5	47	*43
SSPL for shaped noise signal (dB)	122.5	121.5	123.5
with input spl (dB)	74	76	78
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	43	39.5	43
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	37	148	371
800 Hz (%)	5	22	26
1600 Hz (%)	1	1	1
Maximum distortion above 800 Hz (%)	6	24	23
Freq. of max. (Hz)	830	1150	960
Equivalent input noise level (dB)	19	20.5	19
Battery drain (mA)			
No input signal	2.3	2.3	2.4
With shaped input noise level=65dB	2.3	2.3	2.4
Battery voltage (V)	1.32	1.31	1.30

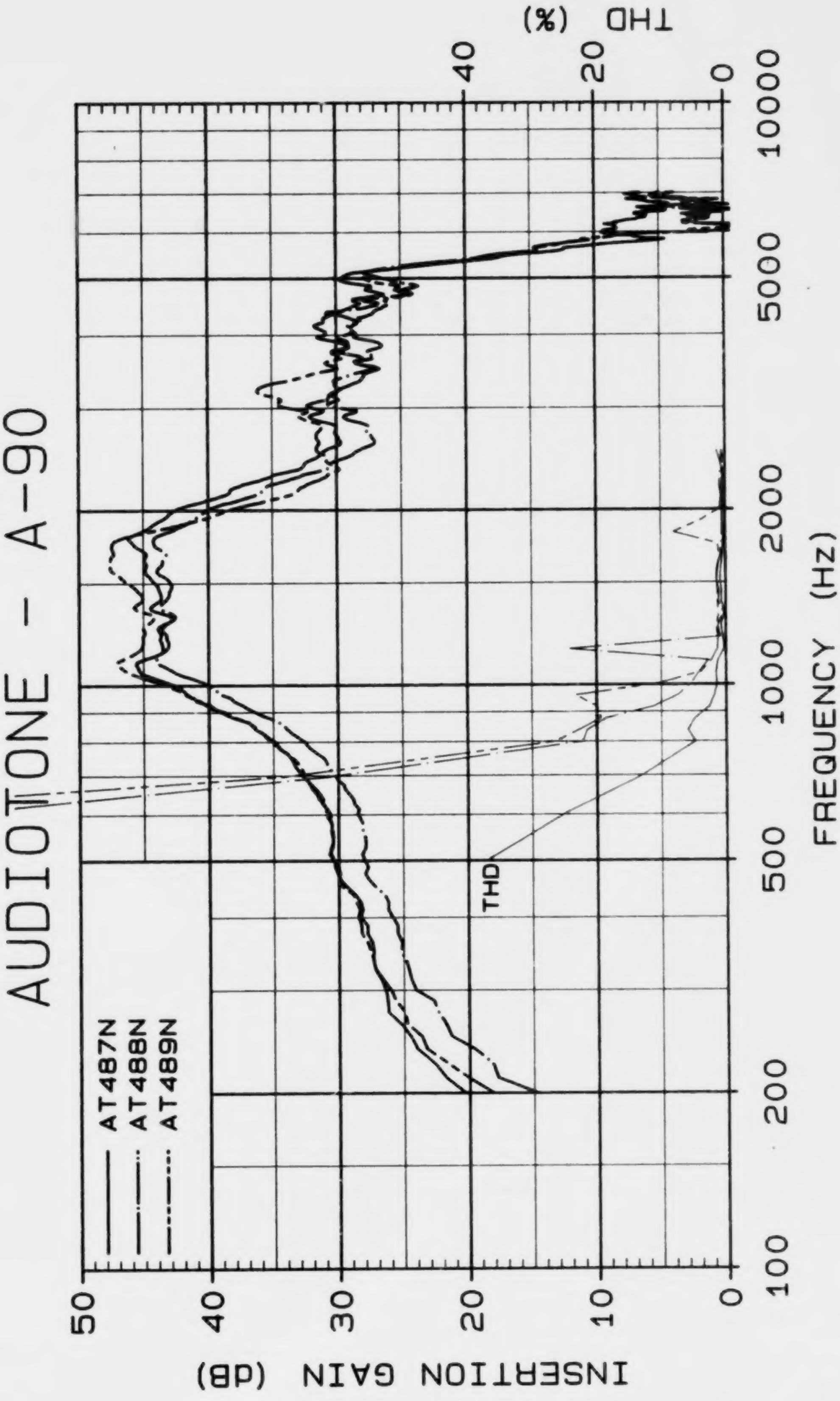
Average insertion gain (dB) in 20 bands (center frequencies shown)

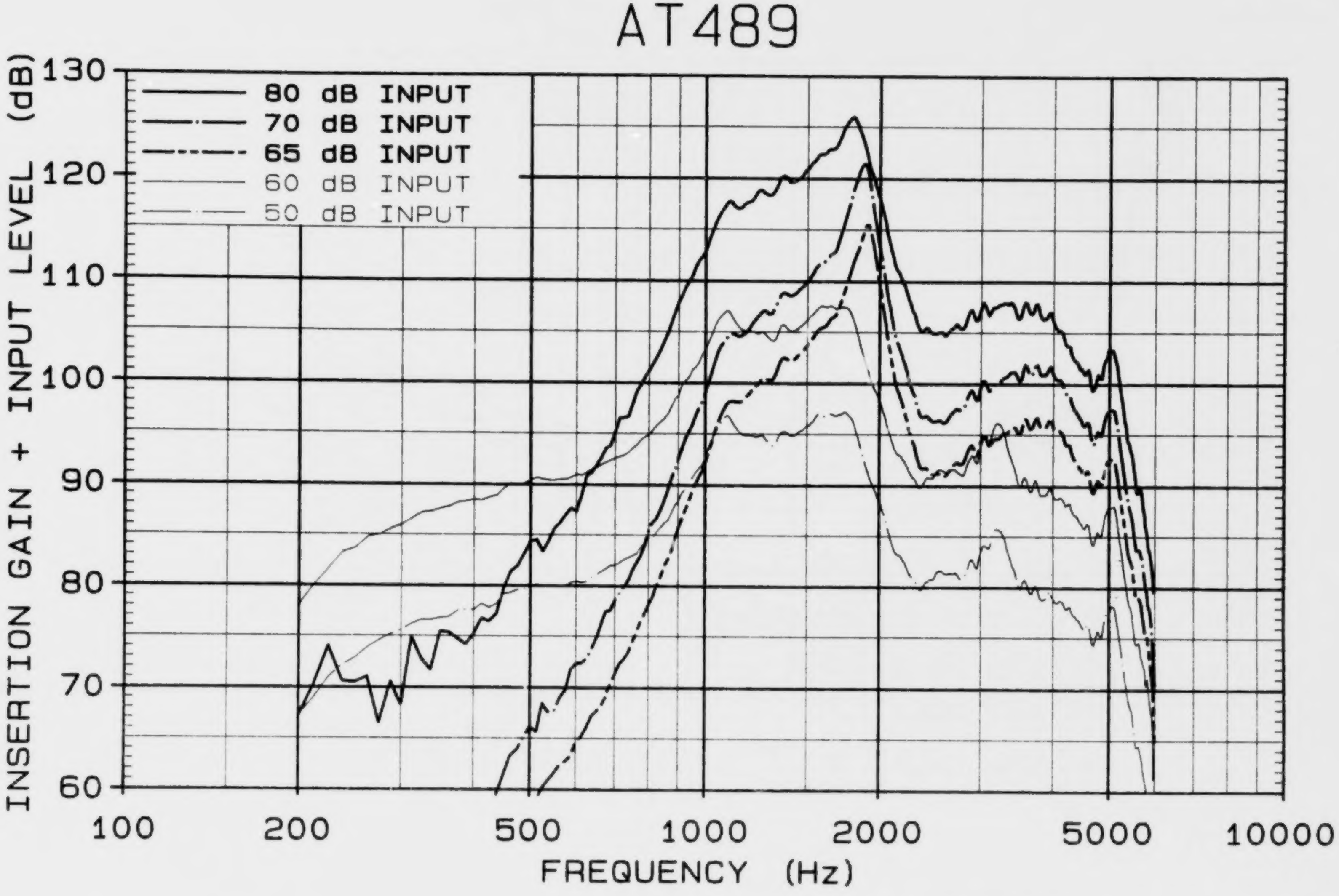
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
AT487	24.5	28	30	31	34.5	39.5	44.5	43	44	44.5
AT488	21	25.5	27.5	29	32	37	42.5	43.5	43	43.5
AT489	24	28	30	31.5	34	39.5	46	45	45	47

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
AT487	45.5	43.5	39	33.5	30	31.5	28	30.5	28.5	16
AT488	44	41.5	36.5	31	27.5	29.5	29	28	26.5	17
AT489	47	41	34	30.5	31.5	34	32.5	29	26.5	16.5

AT488 THD @ 500 Hz WITH SWITCH ON 'N' = 7.5%. edb
AT489 EXTRA HIGH THD @ 500 Hz IS 4th HARMONIC. edb

* The maximum gain was reduced because of feedback edb


AUDIOTONE - A-90
AT487N
AT488N
AT489N
INSERTION GAIN (dB)
0
10
20
30
40
50
THD (%)
0
20
40
THD
FREQUENCY (Hz)
100
200
500
1000
2000
5000
10000


AT489
80 dB INPUT
70 dB INPUT
65 dB INPUT
60 dB INPUT
50 dB INPUT
INSERTION GAIN + INPUT LEVEL (dB)
130
120
110
100
90
80
70
60
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

AUDIOTONE - A-2000 PROG

CO

SETTINGS - AKFB (PROG)
BATTERY - 675

NBS CODE	AT496	AT497	AT498
SERIAL NO.	43AB7	83AB7	71AB7
DATE TESTED	6/30/88	6/30/88	6/30/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	*73.5	*64.5	*67.5
SSPL for shaped noise signal (dB)	134.5	133.5	134.5
with input spl (dB)	66	70	68
Induction coil output level (dB)			
Self noise	92	82.5	86
Vertical field= 10 mA/m	100.5	92.5	98.5
Lateral field= 10 mA/m	114	97.5	105
Longitud field= 10 mA/m	122	110.5	114
Calculated maximum	122.5	111	114.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	57	54	55
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	3	4	3
800 Hz (%)	2	2	2
1600 Hz (%)	1	2	2
Maximum distortion above 800 Hz (%)	3	5	4
Freq. of max. (Hz)	2410	1830	1830
Equivalent input noise level (dB)	20	18.5	19
Battery drain (mA)			
No input signal	1.5	1.3	1.2
With shaped input noise level=65dB	6.5	4.8	4.2
Battery voltage (V)	1.30	1.31	1.30

Average insertion gain (dB) in 20 bands (center frequencies shown)

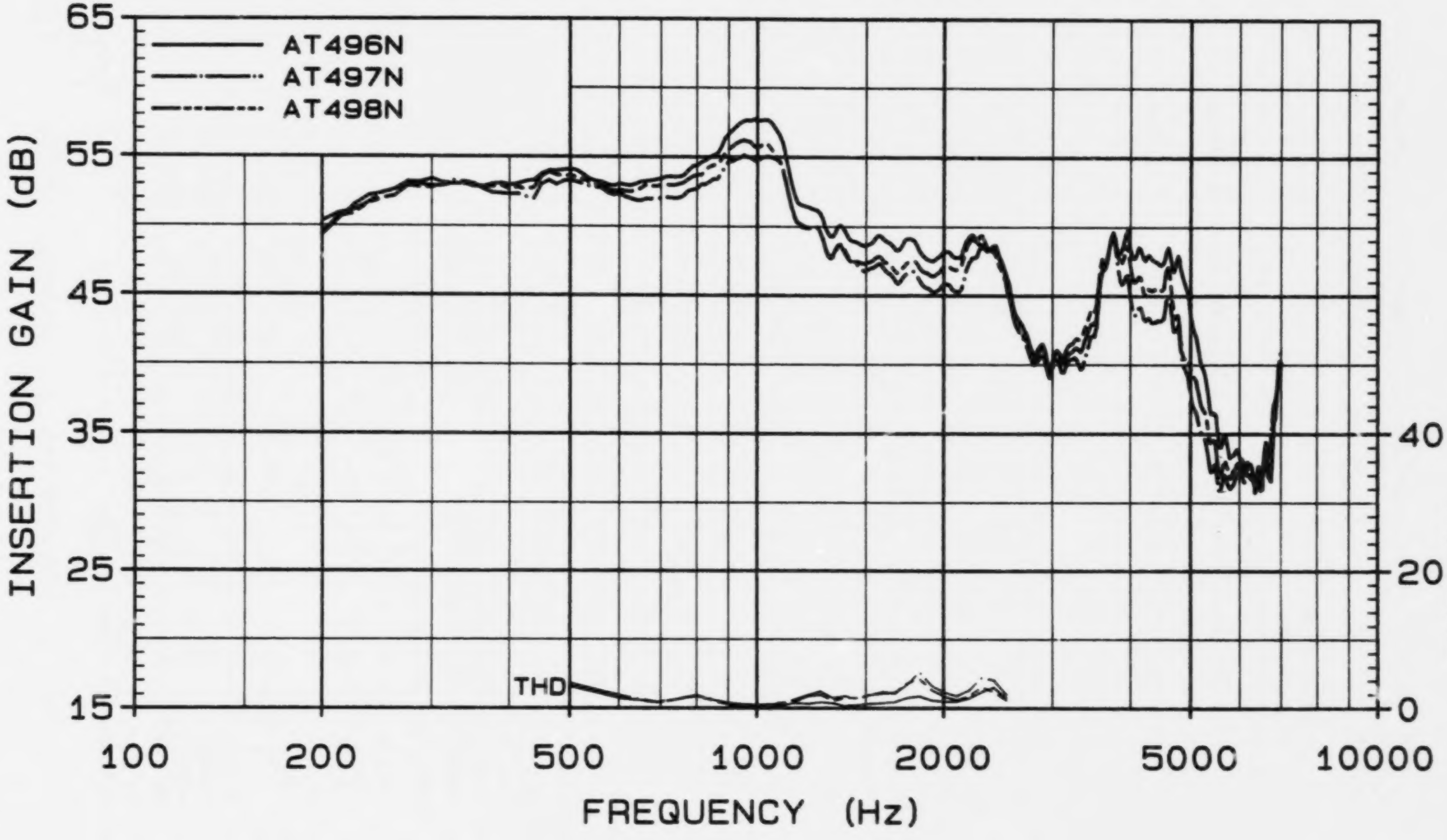
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
AT496	52	53	54	53	54	57	56.5	51	49.5	49
AT497	52	52.5	53	52	52.5	54.5	54	49.5	48	47
AT498	52	53	53.5	52.5	53.5	55.5	54.5	49.5	48	47.5

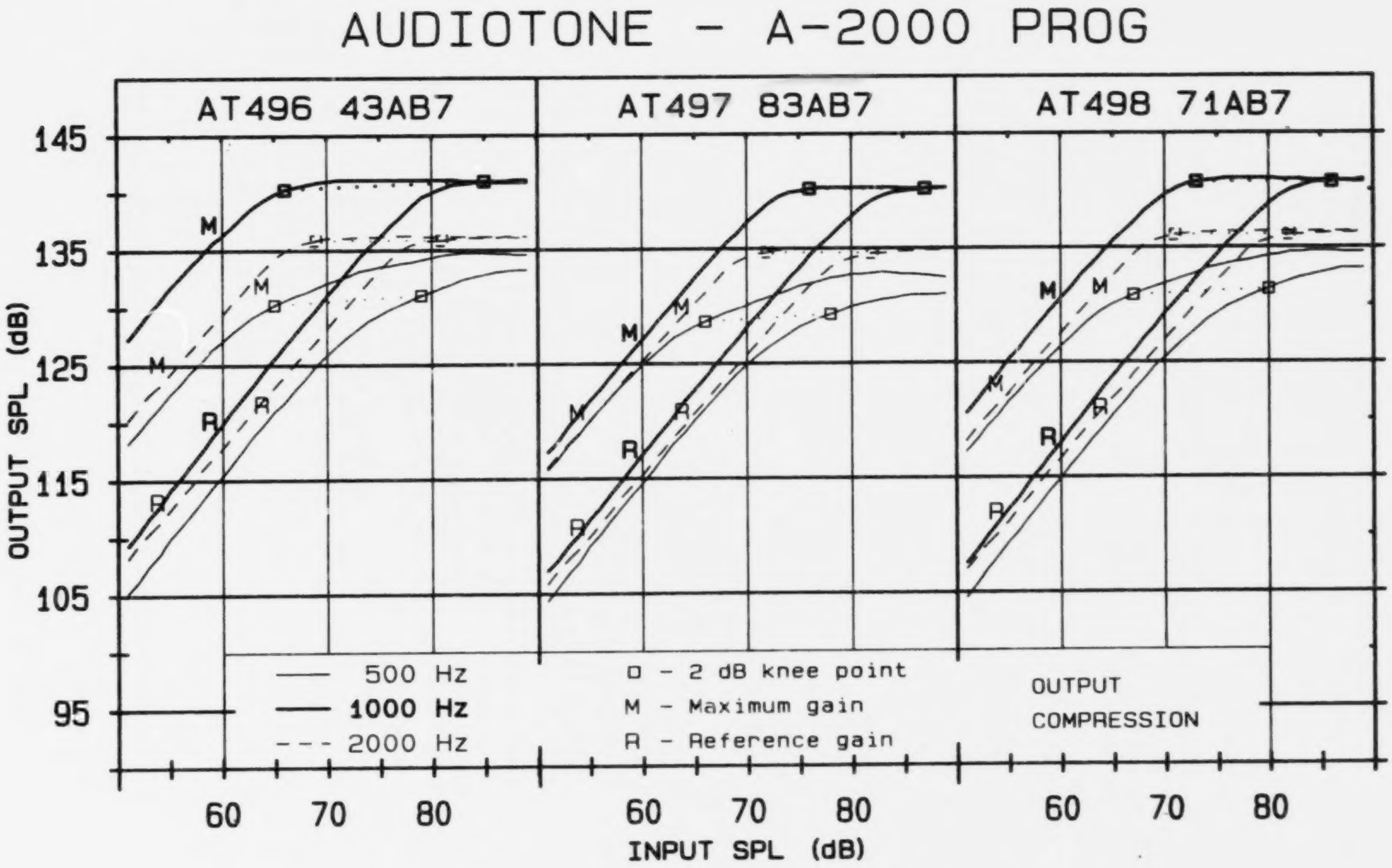
Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
AT496	49	48	48.5	48.5	43.5	40.5	43	48.5	47	36.5
AT497	46.5	45.5	46	48	42.5	40	42	46	42	33
AT498	47	46.5	47.5	48.5	43	40.5	43.5	47.5	44	34.5

* The maximum gain was reduced because of feedback

edb
edb edb

AUDIOTONE - A-2000 PROG





OUTPUT SPL VS. INPUT SPL

AUDIOTONE - A-2000 CO

SETTINGS - BKHP
BATTERY - 675

NBS CODE	AT490	AT491	AT492
SERIAL NO.	44AA7	50AB7	79AB7
DATE TESTED	6/29/88	6/29/88	6/29/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	*68.5	*63.5	*57.5
SSPL for shaped noise signal (dB)	128	122	131
with input spl (dB)	68	78	80
Induction coil output level (dB)			
Self noise	93	90	85.5
Vertical field- 10 mA/m	98.5	98	91
Lateral field- 10 mA/m	108	113	102.5
Longitud field- 10 mA/m	113	122	113
Calculated maximum	114	122.5	113.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	50	46.5	46
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	9	6	5
800 Hz (%)	3	2	1
1600 Hz (%)	2	2	2
Maximum distortion above 800 Hz (%)	3	2	3
Freq. of max. (Hz)	1750	1330	1750
Equivalent input noise level (dB)	21	26	25
Battery drain (mA)			
No input signal	0.8	0.9	1.0
With shaped input noise level-65dB	1.3	1.0	4.0
Battery voltage (V)	1.32	1.33	1.32

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	330	490	630	770	920	1070	1230	1400	1570
AT490	37.5	37	36.5	34.5	37.5	43.5	44.5	42	42.5	43.5
AT491	30	30	29	28	31.5	37.5	39	36.5	36.5	37.5
AT492	41	41	40	38	40.5	46	47.5	45.5	45.5	46.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
AT490	44	44	45	44	39	38	39.5	39	38	27.5
AT491	38	38	39.5	38	32	30.5	34.5	38.5	37.5	27
AT492	46.5	46.5	47.5	46.5	41.5	40.5	43	45	42.5	32.5

* The maximum gain was reduced because of feedback

edb
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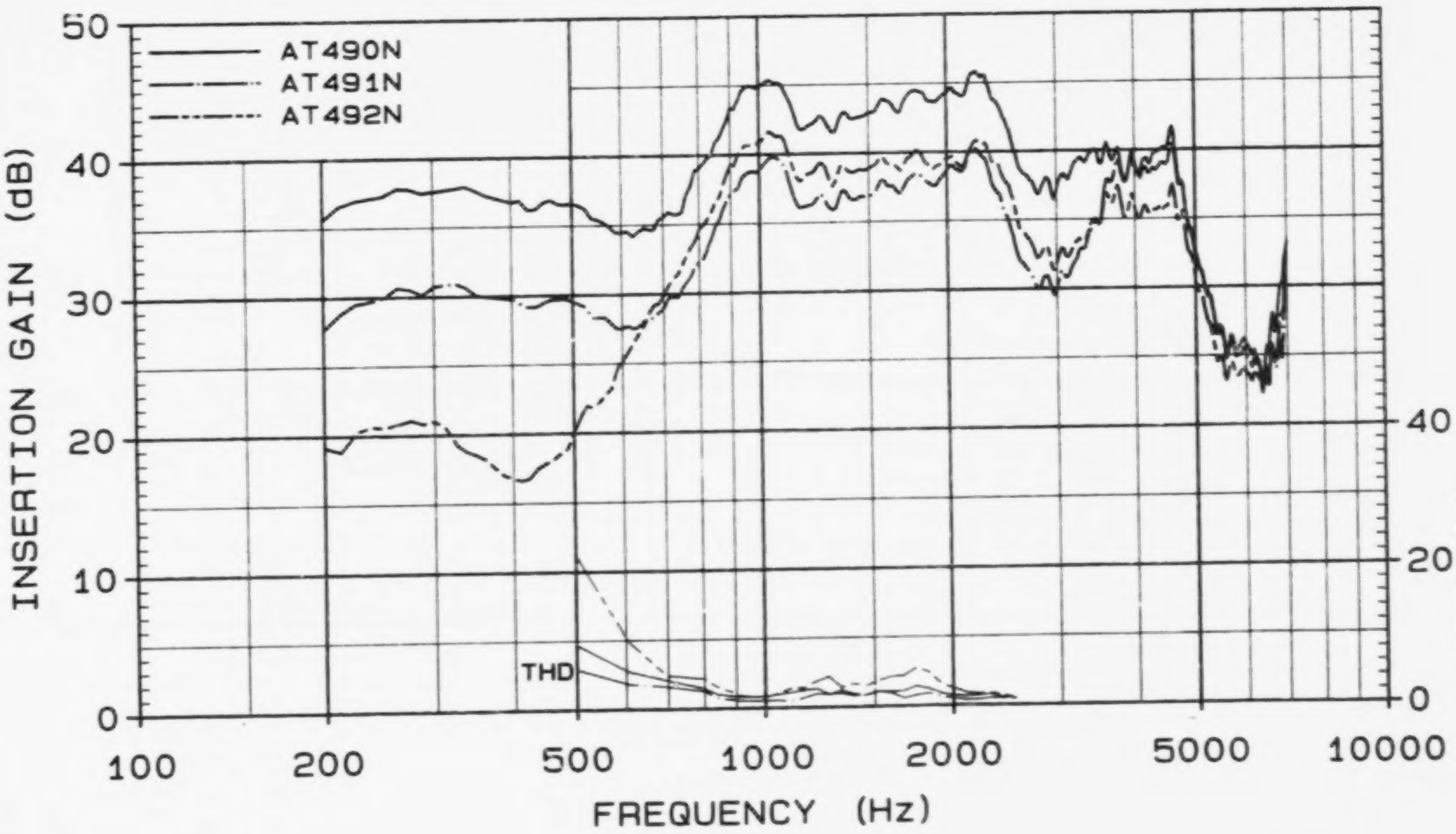
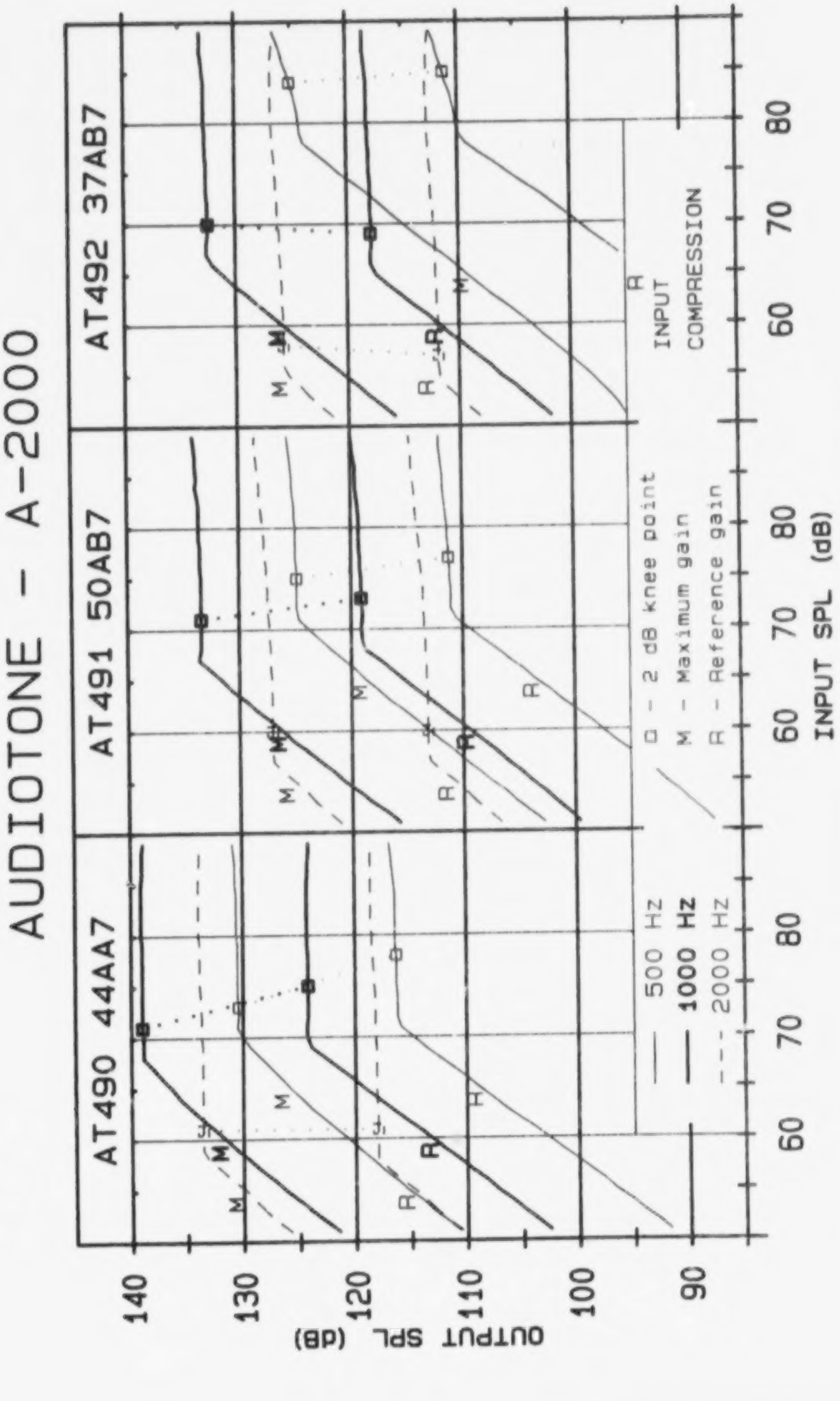


AUDIOTONE - A-2000



OUTPUT SPL VS. INPUT SPL

AUDIOTONE - A-2000

HP

SETTINGS - BKJP
BATTERY - 675

NBS CODE	AT493	AT494	AT495
SERIAL NO.	55AB7	94AB7	58AB7
DATE TESTED	6/30/88	6/30/88	6/30/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	*64.5	*52.5	*63.5
SSPL for shaped noise signal (dB)	123	128.5	120.5
with input spl (dB)	74	68	74
Induction coil output level (dB)			
Self noise	84.5	80	83
Vertical field- 10 mA/m	84.5	80.5	84.5
Lateral field- 10 mA/m	99	94	99
Longitud field- 10 mA/m	115.5	106	110.5
Calculated maximum	116	106.5	111
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	49	44	48
Equivalent input noise level (dB)	20	25.5	21.5
Battery drain (mA)			
No input signal	0.9	0.9	0.9
With shaped input noise level-65dB	1.1	2.5	1.1
Battery voltage (V)	1.33	1.33	1.33

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
AT493	21	17.5	19.5	26.5	33.5	40	41.5	39	38.5	39
AT494	38.5	38.5	37.5	36	38.5	44	45	42.5	43	44
AT495	16.5	14	19	25.5	31.5	37	39	36.5	36.5	37

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
AT493	39.5	39	39.5	39.5	34.5	33	36	35.5	34.5	25.5
AT494	44.5	44	45	44	38.5	38	40.5	42.5	39	30.5
AT495	37	36.5	37	36.5	31.5	29.5	31.5	33.5	32	22.5

* The maximum gain was reduced because of feedback

edb
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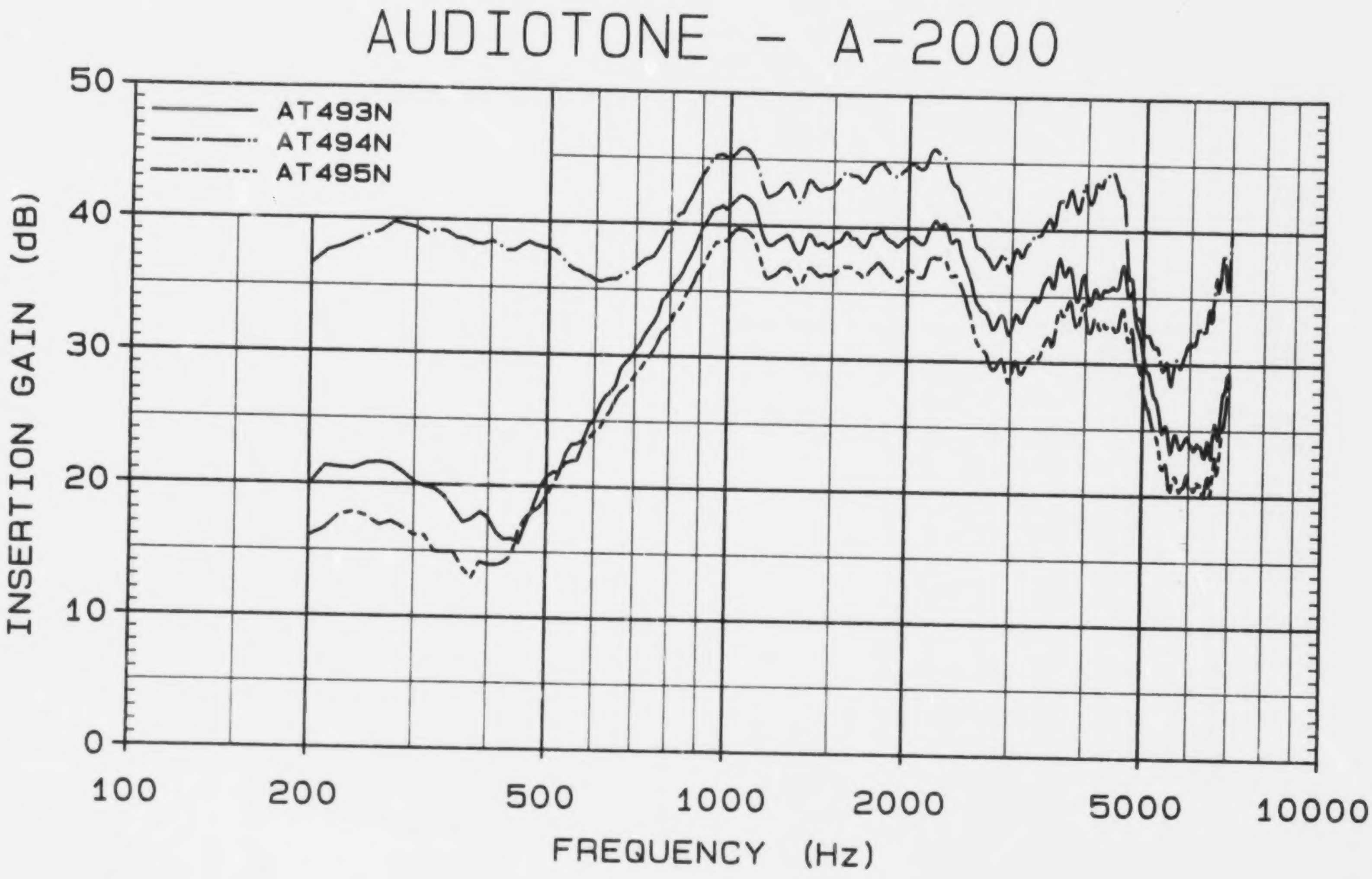

AUDIOTONE - A-2000
AT493N
AT494N
AT495N
INSERTION GAIN (dB)
50
40
30
20
10
0
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

BELTONE - JUBILEE V **HP**

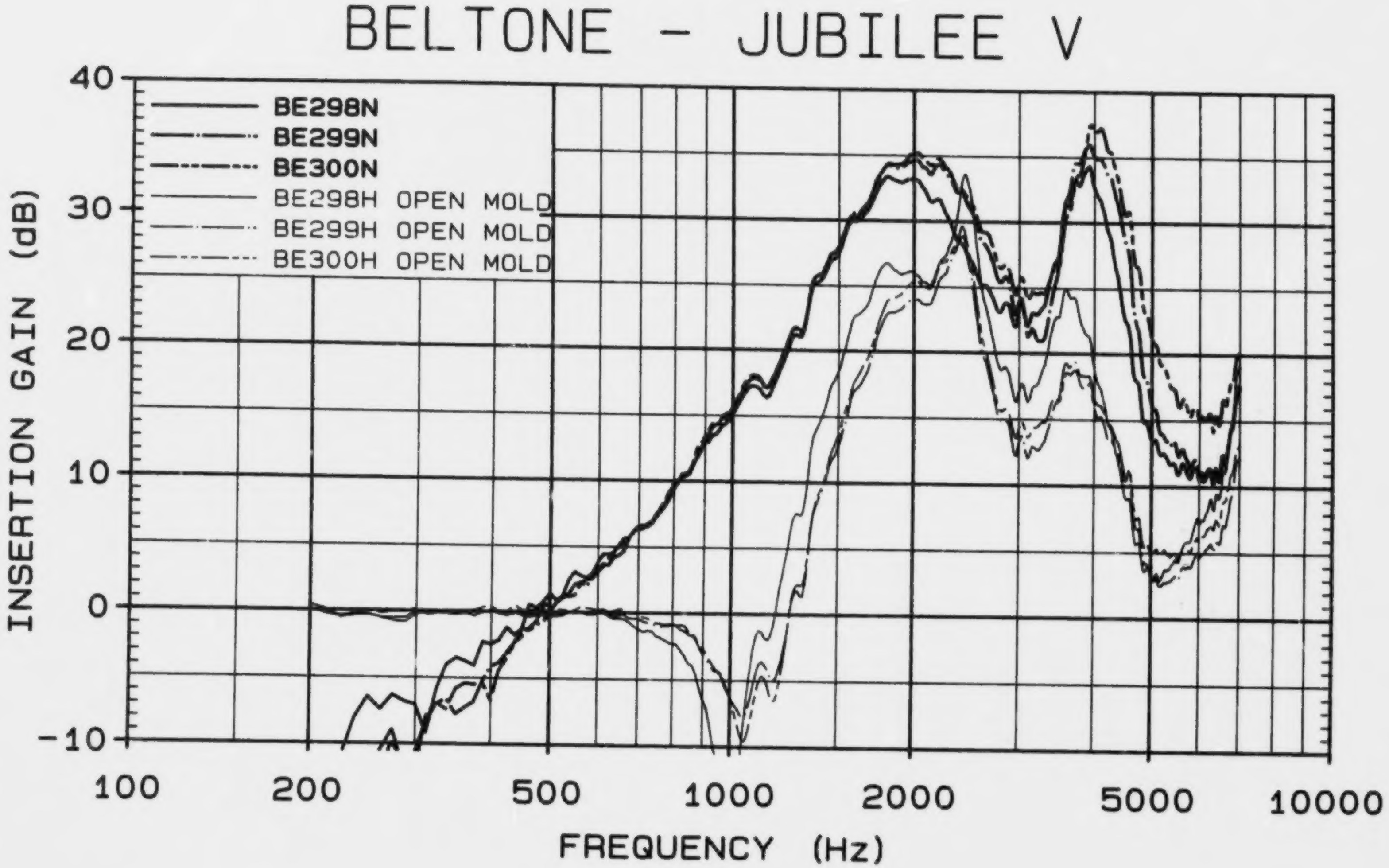
SETTINGS - SSPL:115 Tone:H
BATTERY - 13

NBS CODE	BE298	BE299	BE300
SERIAL NO.	JU08467	JU08464	JU07715
DATE TESTED	4/20/88	4/20/88	4/20/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	18.5	29.5	27
SSPL for shaped noise signal (dB)	114	117	116.5
with input spl (dB)	78	68	70
Induction coil output level (dB)			
Self noise	62	71	72.5
Vertical field= 10 mA/m	90.5	101.5	102.5
Lateral field= 10 mA/m	77	88.5	92.5
Longitud field= 10 mA/m	72	84.5	83
Calculated maximum	91	101.5	102.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	15	15.5	15.5
Equivalent input noise level (dB)	23	17	19.5
Battery drain (mA)			
No input signal	1.2	1.2	1.1
With shaped input noise level=65dB	1.2	1.2	1.1
Battery voltage (V)	1.32	1.32	1.32

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
BE298	-9	-3	1	4.5	8.5	13	16.5	19.5	25	29.5
BE299	-12.5	-5.5	0	4	8.5	13.5	17	20	25.5	30
BE300	-12	-5.5	0	4	8.5	13.5	17.5	20	25.5	29.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
BE298	32.5	33	32	29	25	23	27	32.5	20	11.5
BE299	33	34.5	34	32.5	28	23.5	25.5	35	24.5	13
BE300	33	34.5	34.5	33	28.5	25.5	26.5	35.5	28	17.5
							edb	edb	edb	


BELTONE - JUBILEE V
BE298N
BE299N
BE300N
BE298H OPEN MOLD
BE299H OPEN MOLD
BE300H OPEN MOLD
INSERTION GAIN (dB)
40
30
20
10
0
-10
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

BELTONE - SUPRIMO V **CO**

SETTINGS - L:1 H:5 FR:5 AO:ON TH:1 G:5 CR:2 P:5
BATTERY - 675

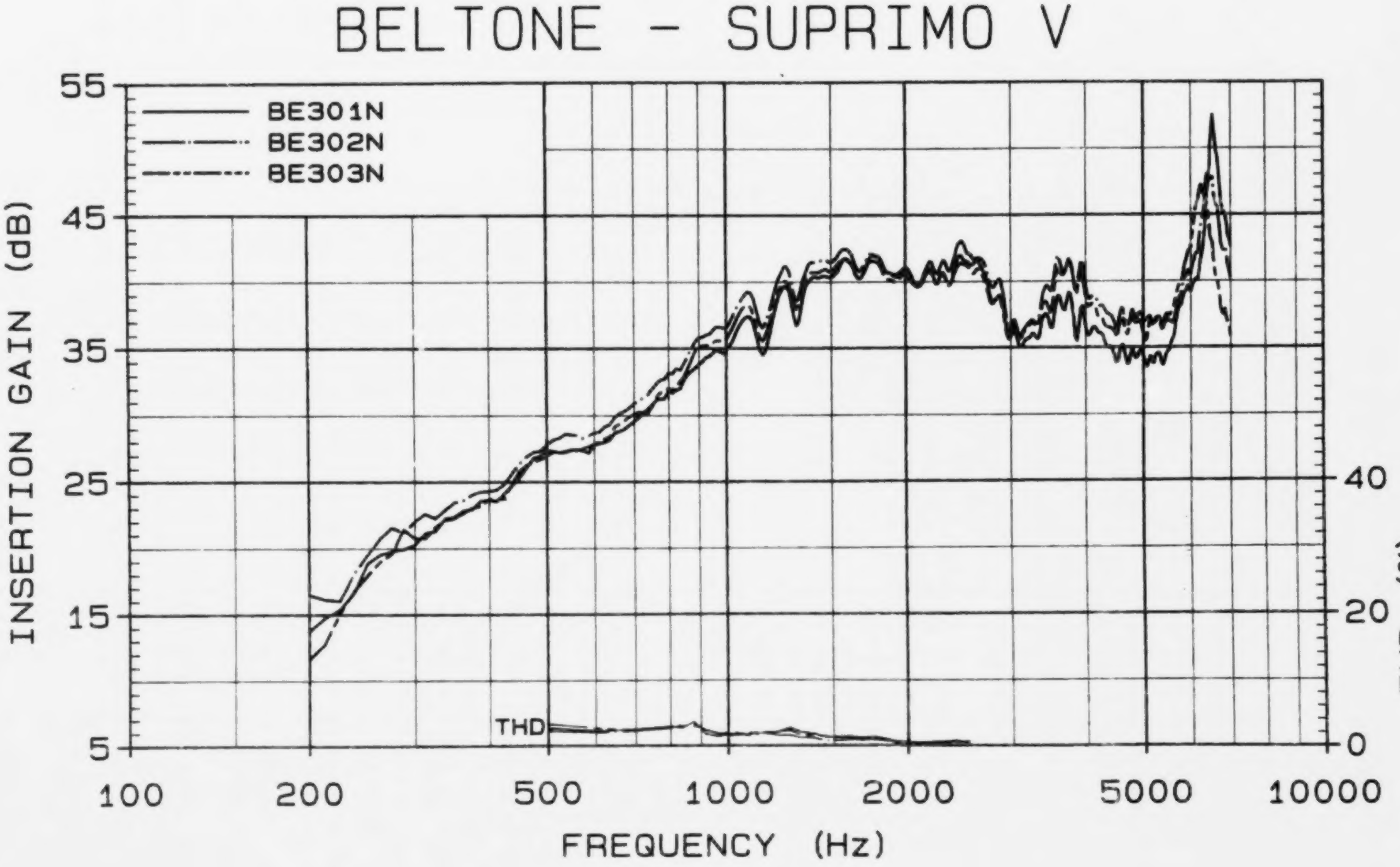
NBS CODE	BE301	BE302	BE303
SERIAL NO.	SU09335	SU09349	SU09362
DATE TESTED	5/9/88	5/9/88	5/9/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	53	58	58
SSPL for shaped noise signal (dB)	126.5	127	126.5
with input spl (dB)	70	70	72
Induction coil output level (dB)			
Self noise	100.5	98.5	99.5
Vertical field- 10 mA/m	121.5	119	121
Lateral field- 10 mA/m	102.5	104	105
Longitud field- 10 mA/m	117.5	118	118
Calculated maximum	123	121.5	122.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	40	40.5	40.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	3	2	3
800 Hz (%)	3	3	3
1600 Hz (%)	1	1	1
Maximum distortion above 800 Hz (%)	4	3	3
Freq. of max. (Hz)	880	830	880
Equivalent input noise level (dB)	33	31	32
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.35	1.33	1.33

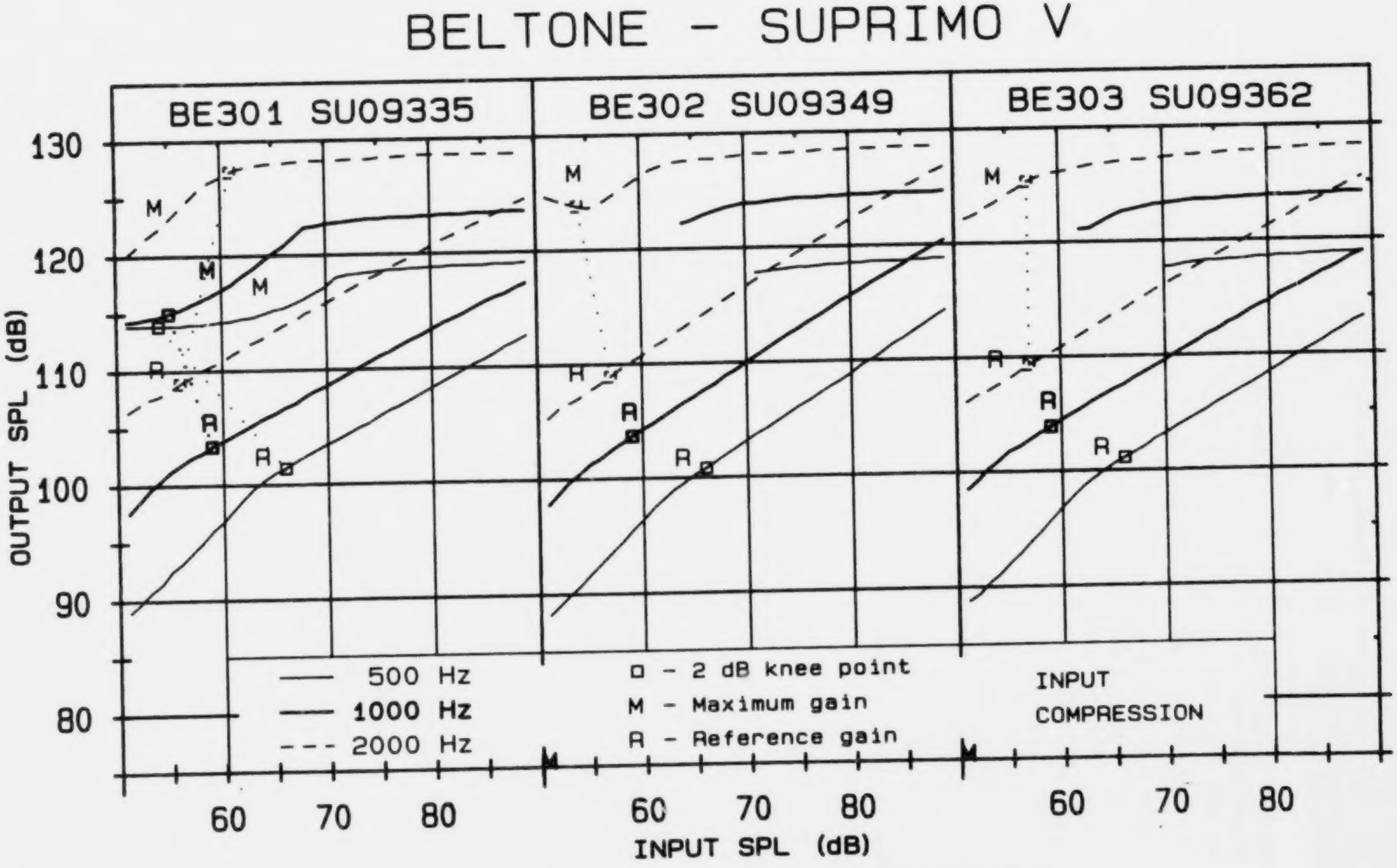
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
BE301	18.5	23	26.5	28	31	34	36.5	37.5	39.5	41
BE302	19.5	24	27.5	29.5	32.5	35.5	38	39.5	41	42
BE303	18	23	26.5	28.5	31.5	35	37	38.5	40	41

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
BE301	41.5	41	40.5	41.5	41	36.5	37	37	34.5	36
BE302	41.5	40.5	40.5	40.5	41	37.5	39	40	37.5	38
BE303	41	40.5	40	40.5	40	37	38	39.5	36.5	38.5

ts ts ts


BELTONE - SUPRIMO V
BE301N
BE302N
BE303N
INSERTION GAIN (dB)
55
45
35
25
15
5
THD
40
20
0
THD (%)
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)



OUTPUT SPL VS. INPUT SPL

BERNAFON - C2

CO

SETTINGS - Low:+1 HiGH:+1 AGC-I:63 PC-C:130
BATTERY - 13

NBS CODE	BR067	BR068	BR069
SERIAL NO.	43728	43733	43779
DATE TESTED	5/13/88	5/13/88	5/13/88

DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING

Gain at 1kHz (dB)	50.5	50	49
SSPL for shaped noise signal (dB)	127.5	128.5	128.5
with input spl (dB)	72	72	74
Induction coil output level (dB)			
Self noise	80.5	84.5	83
Vertical field- 10 mA/m	105.5	111	104
Lateral field- 10 mA/m	89	85	83
Longitud field- 10 mA/m	96	100.5	102
Calculated maximum	107	111	107.5

DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING

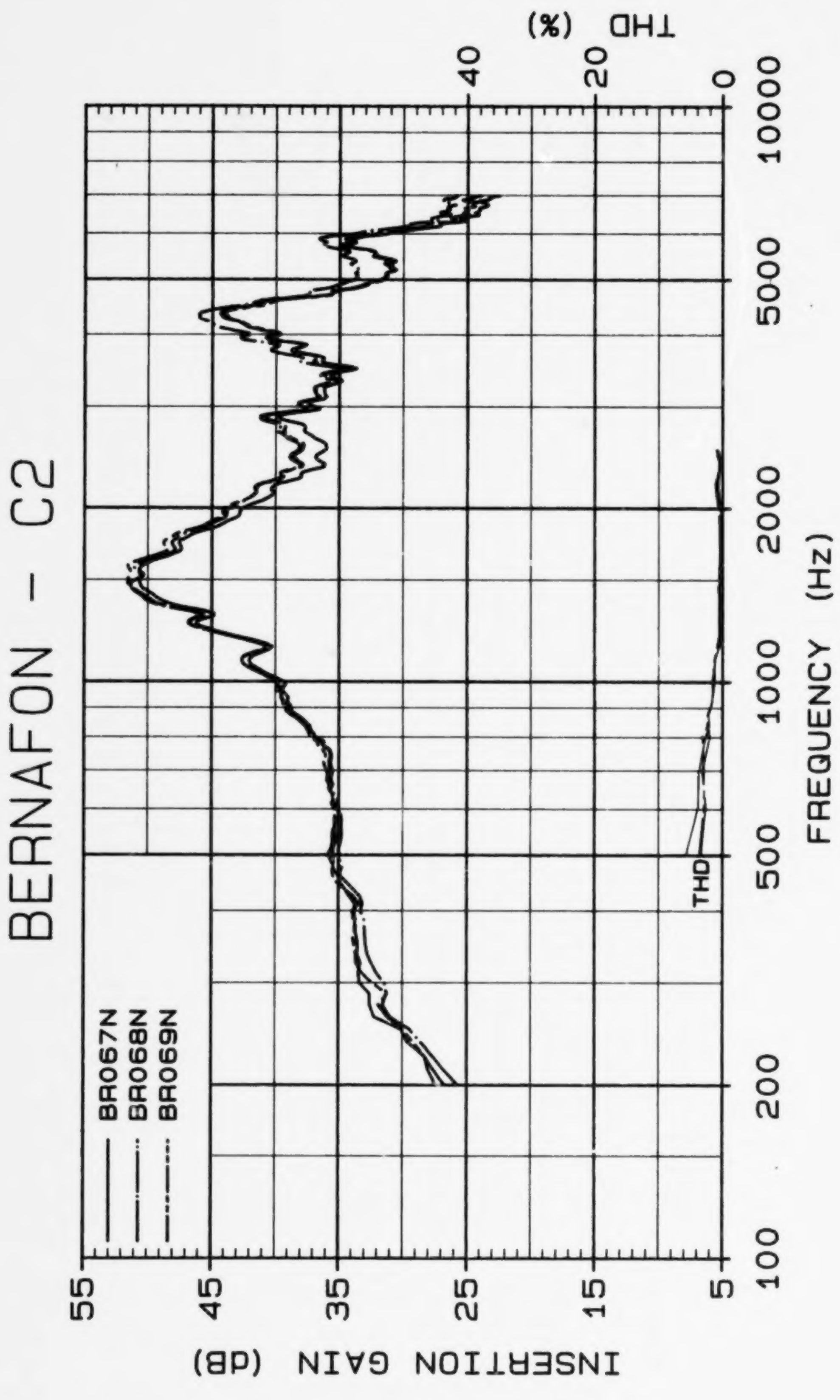
Gain at 1kHz (dB)	39.5	39.5	40
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	6	3	4
800 Hz (%)	3	2	3
1600 Hz (%)	0	0	0
Maximum distortion above 800 Hz (%)	2	2	2
Freq. of max. (Hz)	880	880	830
Equivalent input noise level (dB)	24.5	25	24
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.33	1.33	1.33

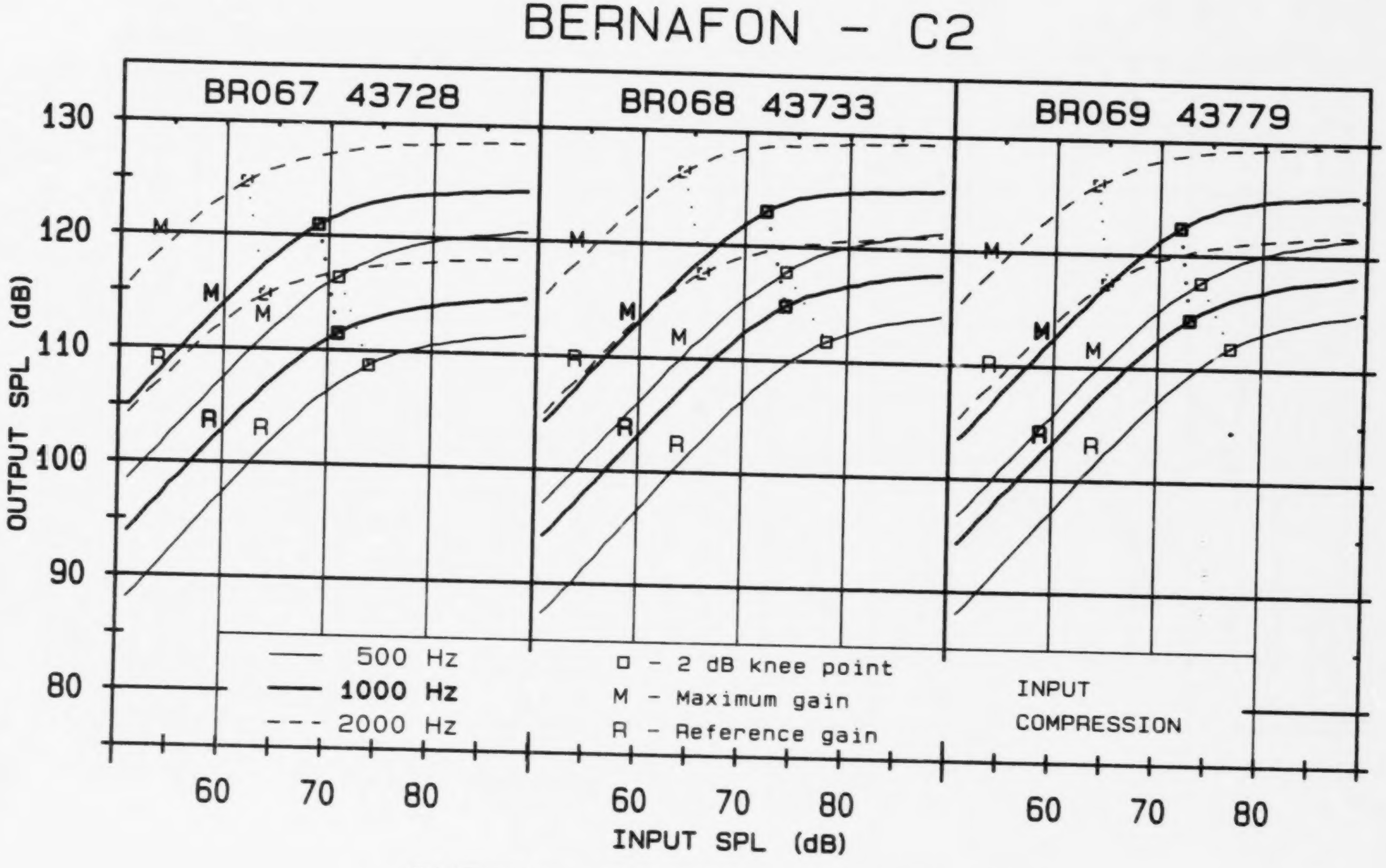
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
BR067	31	33.5	35	35.5	36.5	39	41	44	48.5	50
BR068	30	33	34.5	35	36	39	41.5	44.5	49.5	50.5
BR069	30.5	34	35.5	35.5	36.5	39.5	41.5	44.5	49.5	51

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
BR067	47	43.5	40.5	37	37	37.5	35.5	40	38.5	32.5
BR068	47.5	44.5	41.5	39	39	38.5	36.5	42	40	34.5
BR069	48.5	44.5	41.5	38.5	38.5	38.5	36	40	38	32.5

ts ts ts


BERNAFON - C2
BR067N
BR068N
BR069N
INSERTION GAIN (dB)
55
45
35
25
15
5
THD (%)
40
20
0
THD
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)



OUTPUT SPL VS. INPUT SPL

BERNAFON - C2H HP

SETTINGS - Low:-3 High:+5 AGC-I:OFF PC-C:125
BATTERY - 13

NBS CODE	BR070	BR071	BR072
SERIAL NO.	47466	47499	47492
DATE TESTED	4/20/88	6/9/88	4/20/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	22	25	24.5
SSPL for shaped noise signal (dB)	122.5	123.5	125
with input spl (dB)	74	72	74
Induction coil output level (dB)			
Self noise	79.5	83.5	80
Vertical field= 10 mA/m	88.5	91	89
Lateral field= 10 mA/m	82	85	82
Longitud field= 10 mA/m	80	83.5	82
Calculated maximum	91	93.5	91.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	17	19	19.5
Equivalent input noise level (dB)	33	34	31
Battery drain (mA)			
No input signal	0.9	1.0	0.9
With shaped input noise level=65dB	1.4	1.7	1.4
Battery voltage (V)	1.34	1.31	1.33

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
BR070	-16	-12	-4	1	7	13.5	18	21.5	27	30
BR071	-19	-10.5	-3.5	2.5	8.5	15.5	21	24.5	30	33
BR072	-18.5	-9	-2	3.5	9.5	16.5	21.5	25	30.5	33

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
BR070	32	32	31.5	31.5	34.5	39	39	39.5	36.5	36.5
BR071	34	33.5	33	32.5	34.5	39	39.5	43.5	40	38.5
BR072	34.5	34.5	33.5	33	35.5	40.5	41.5	44	38.5	35.5

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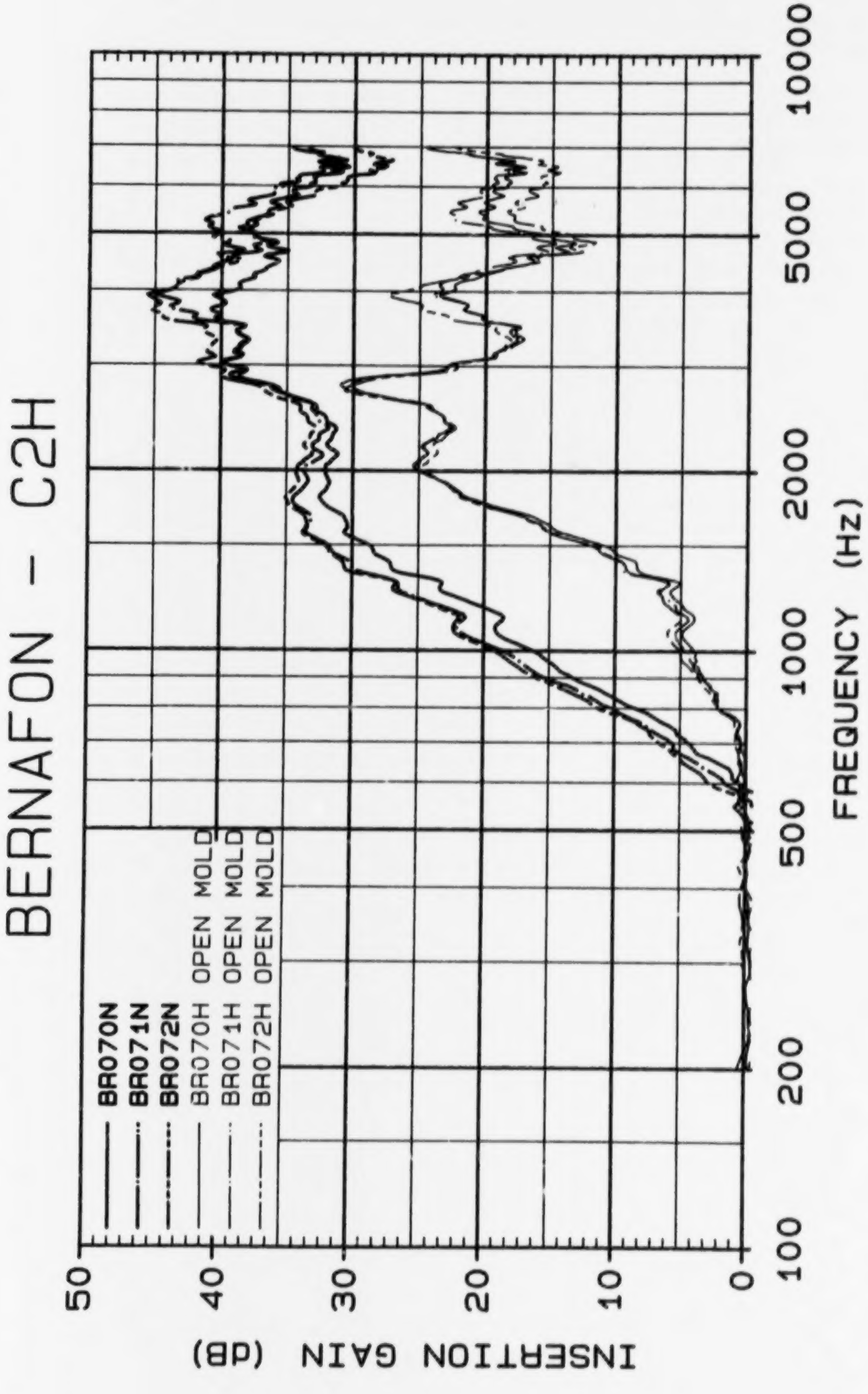


BERNAFON - C2H

BERNAFON - T86 **HP**

SETTINGS - Low:-3 High:+1 PC-C:128 AGC-I:OFF
BATTERY - 675

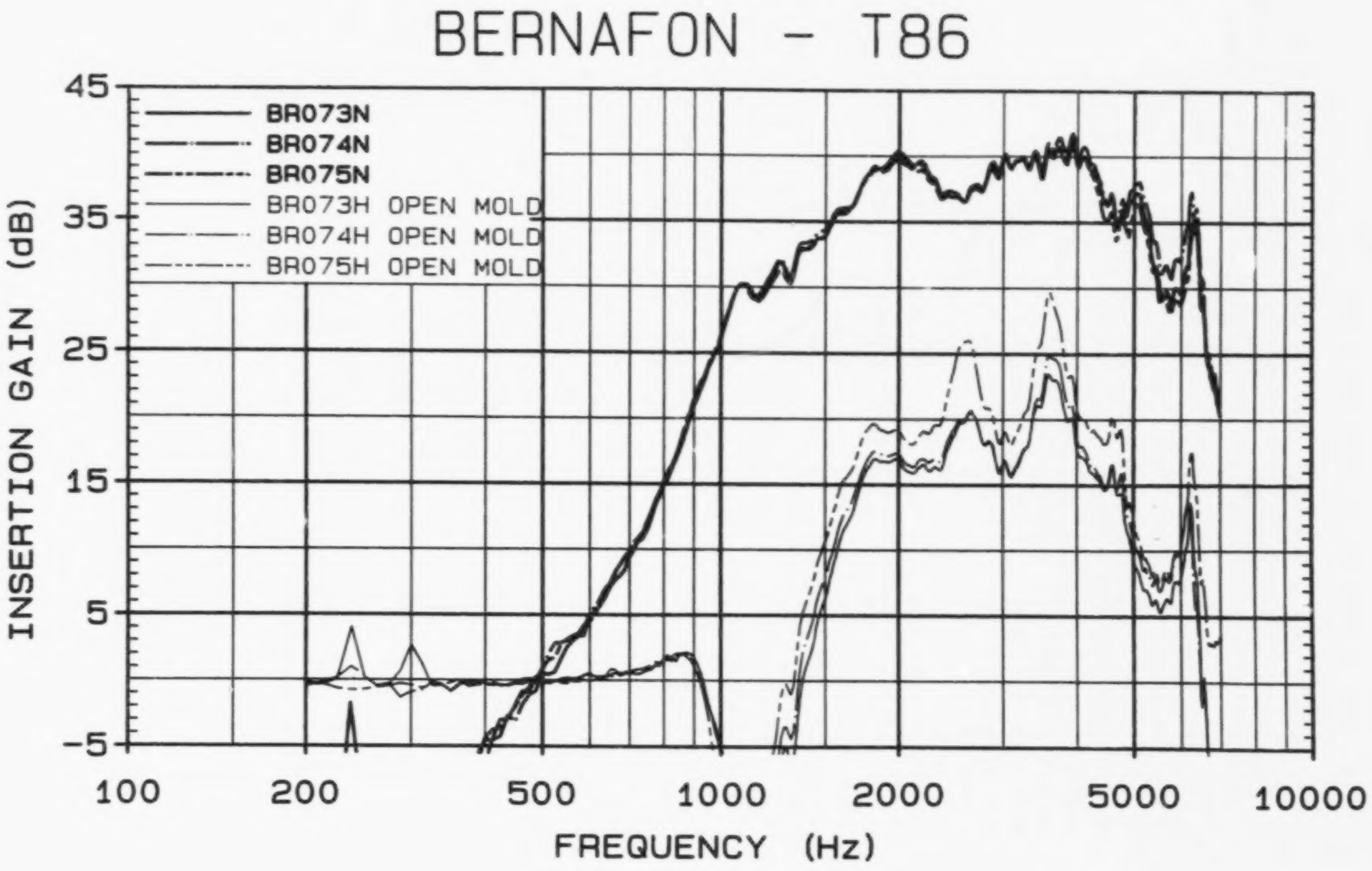
NBS CODE	BR073	BR074	BR075
SERIAL NO.	301151	301127	301156
DATE TESTED	5/2/88	5/2/88	5/2/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	37.5	37.5	37.5
SSPL for shaped noise signal (dB)	125.5	125	125
with input spl (dB)	72	72	72
Induction coil output level (dB)			
Self noise	69	70.5	68
Vertical field- 10 mA/m	90.5	92	89
Lateral field- 10 mA/m	77	79	75
Longitud field- 10 mA/m	73.5	77.5	72.5
Calculated maximum	91	92.5	89.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	25.5	25.5	26
Equivalent input noise level (dB)	23.5	22	21.5
Battery drain (mA)			
No input signal	1.8	1.8	1.8
With shaped input noise level=65dB	1.8	1.8	1.8
Battery voltage (V)	1.33	1.33	1.33

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
BR073	-13.5	-6.5	0	6	13	22	29	30.5	32.5	35
BR074	-15.5	-7	0	6	13.5	22	29	31	33	35.5
BR075	-15	-6.5	0.5	6	13.5	22	29	30	32.5	35

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
BR073	38	39.5	39.5	37.5	37	39.5	39.5	40	36.5	32
BR074	38	39.5	39	37.5	37.5	39.5	40	40.5	37	33.5
BR075	38	39	39	37	37	39	39.5	40	35.5	31

ts ts ts


BERNAFON - T86
BR073N
BR074N
BR075N
BR073H OPEN MOLD
BR074H OPEN MOLD
BR075H OPEN MOLD
INSERTION GAIN (dB)
45
35
25
15
5
-5
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

ASP

BOSCH - STARPP-ANR

SETTINGS - ANR:-21 SSPL:0(128)
BATTERY - 13

NBS CODE	B0259	B0260	B0261
SERIAL NO.	7484888	7493908	7493868
DATE TESTED	6/27/88	6/28/88	6/28/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	46.5	49	48.5
SSPL for shaped noise signal (dB)	129	129	129
with input spl (dB)	82	82	82
Induction coil output level (dB)			
Self noise	72.5	76	75
Vertical field- 10 mA/m	110	110.5	111.5
Lateral field- 10 mA/m	81	89	80
Longitud field- 10 mA/m	100.5	100.5	99.5
Calculated maximum	110.5	111	112
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	46.5	47.5	47.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	2	2	2
800 Hz (%)	2	2	2
1600 Hz (%)	1	1	1
Maximum distortion above 800 Hz (%)	3	3	2
Freq. of max. (Hz)	2410	2410	1750
Equivalent input noise level (dB)	20.5	21	22
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	N.M.	N.M.	N.M.

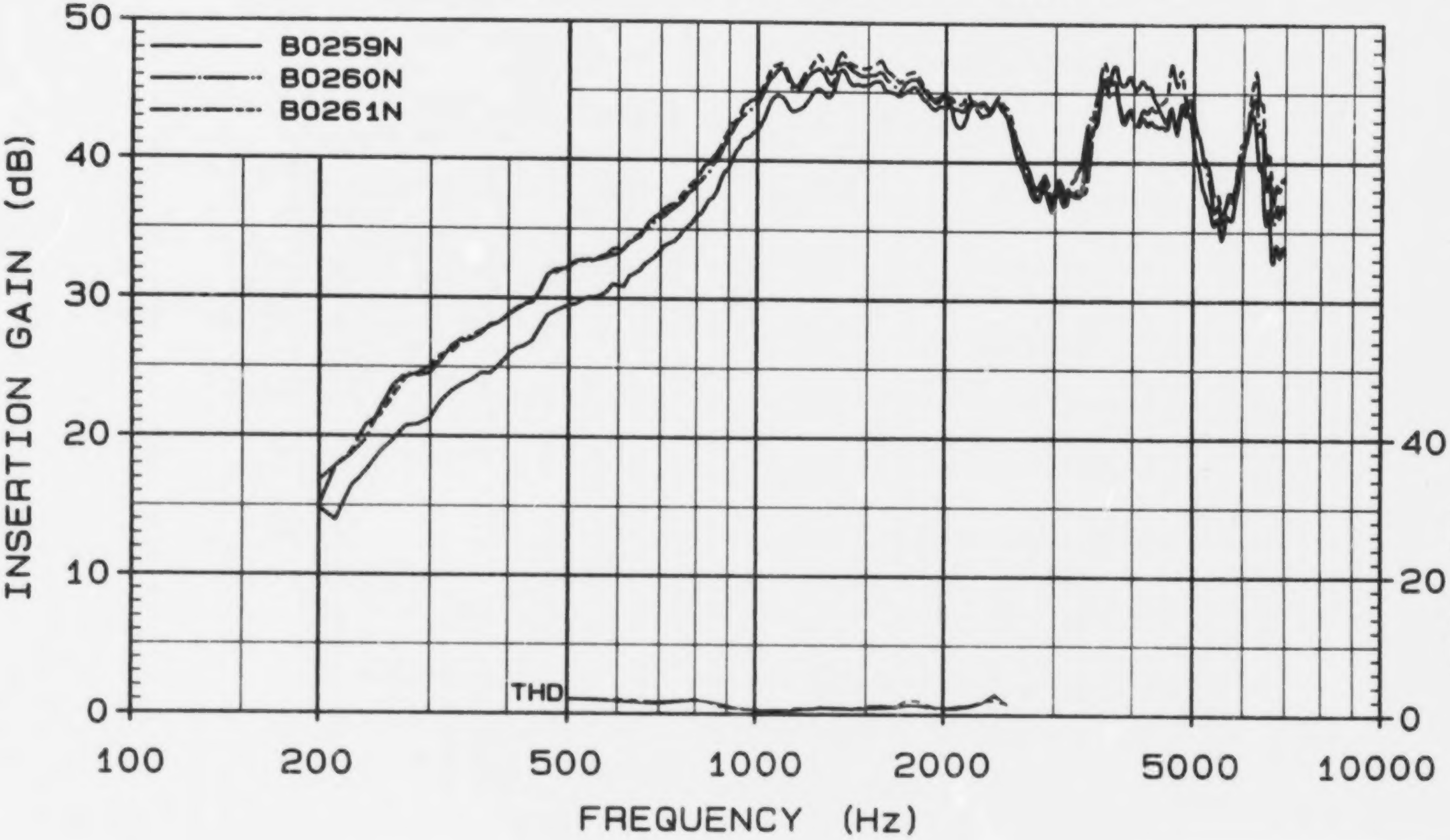
Average insertion gain (dB) in 20 bands (center frequencies shown)

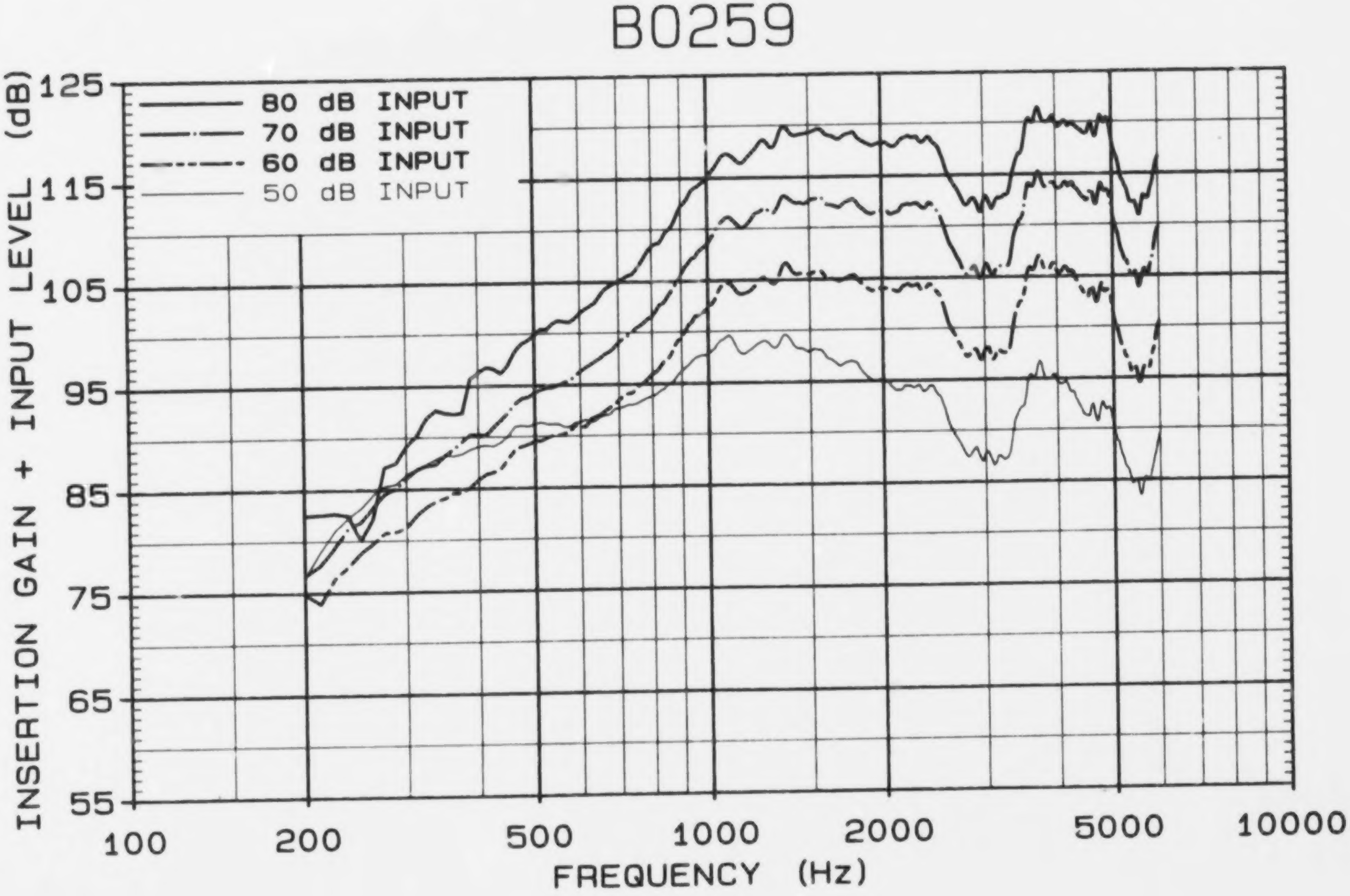
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
B0259	19	25	29	31.5	35	40	44	44.5	46	45.5
B0260	22	28	32	34	37.5	42	45.5	46	46.5	46
B0261	22	28	32	34.5	38	42.5	46	46.5	47	47

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
B0259	45	44	44	44	40	37.5	41.5	46	43.5	37
B0260	45.5	45	43.5	44	40.5	38	42.5	43.5	43	38.5
B0261	46	44.5	44.5	44	40.5	38	41.5	44	45	39

edb edb edb

BOSCH - STARPP-ANR




B0259
80 dB INPUT
70 dB INPUT
60 dB INPUT
50 dB INPUT
INSERTION GAIN + INPUT LEVEL (dB)
125
115
105
95
85
75
65
55
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

BOSCH - STAR33PP-CTC **HP**

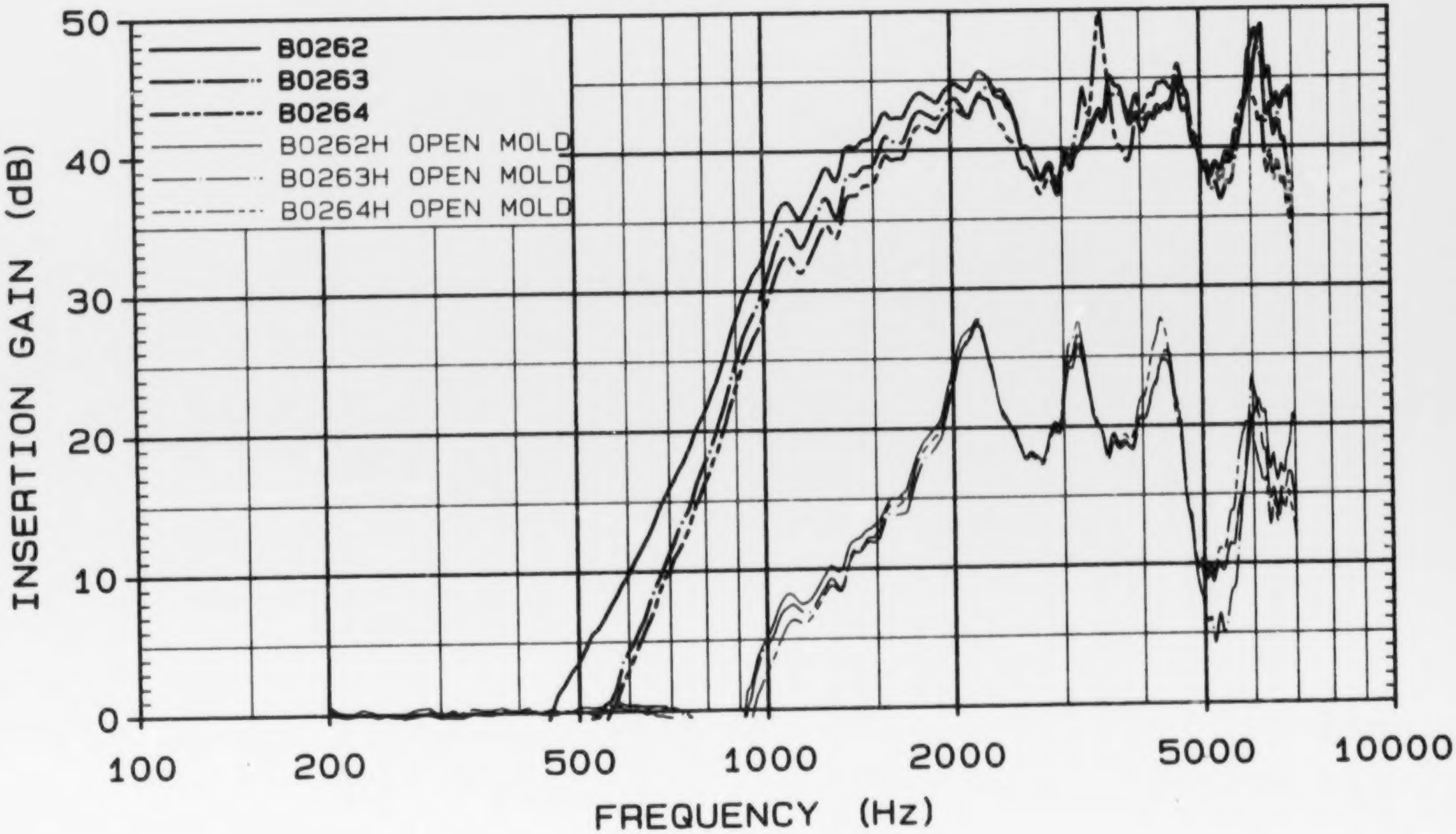
SETTINGS - TONE:H3 P:128
BATTERY - 13

NBS CODE	BO262	BO263	BO264
SERIAL NO.	7522883	7522920	7523774
DATE TESTED	4/12/88	4/13/88	4/13/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	33.5	30	29
SSPL for shaped noise signal (dB)	128.5	128	128
with input spl (dB)	78	78	78
Induction coil output level (dB)			
Self noise	68.5	67	67.5
Vertical field- 10 mA/m	98	95	94.5
Lateral field- 10 mA/m	77	77.5	75.5
Longitud field- 10 mA/m	69	77.5	77.5
Calculated maximum	98	95	95
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	32	29.5	27.5
Equivalent input noise level (dB)	21.5	22	22.5
Battery drain (mA)			
No input signal	0.6	N.M.	0.6
With shaped input noise level-65dB	1.0	N.M.	0.8
Battery voltage (V)	1.35	N.M.	1.32

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
BO262	-20.5	-7	3	11.5	19.5	28.5	35	37.5	40	42
BO263	-19.5	-14.5	-4	6	15.5	25.5	33	35	38	40
BO264	-17	-13	-4.5	4.5	14.5	24	31	33.5	36.5	39

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
BO262	43.5	44	45	44	40	38.5	42	42.5	42	40
BO263	42	43	43	44	40	39	43	43	42.5	39
BO264	41	42	43	42	38.5	38	44.5	41.5	43	40
							edb	edb	edb	



BOSCH - STAR33PP-CTC

ELECTONE - AM34AGC CO

SETTINGS - PC:CCW (Min peak clipping) A1:CCW (Max comp)
BATTERY - 675

NBS CODE	EL007	EL008	EL009
SERIAL NO.	MF5269	MF5200	JF5769
DATE TESTED	5/10/88	5/10/88	5/10/88

DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING

Gain at 1kHz (dB)	56.5	56.5	57.5
SSPL for shaped noise signal (dB)	125	124.5	125.5
with input spl (dB)	82	84	82
Induction coil output level (dB)			
Self noise	74	73	76
Vertical field- 10 mA/m	101	102	101.5
Lateral field- 10 mA/m	86.5	92.5	88
Longitud field- 10 mA/m	96	95.5	97
Calculated maximum	102	103.5	103

DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING

Gain at 1kHz (dB)	45.5	45.5	46
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	4	3	3
800 Hz (%)	2	2	1
1600 Hz (%)	1	2	1
Maximum distortion above 800 Hz (%)	2	2	1
Freq. of max. (Hz)	1210	1150	1150
Equivalent input noise level (dB)	21	20	20
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.33	1.32	1.32

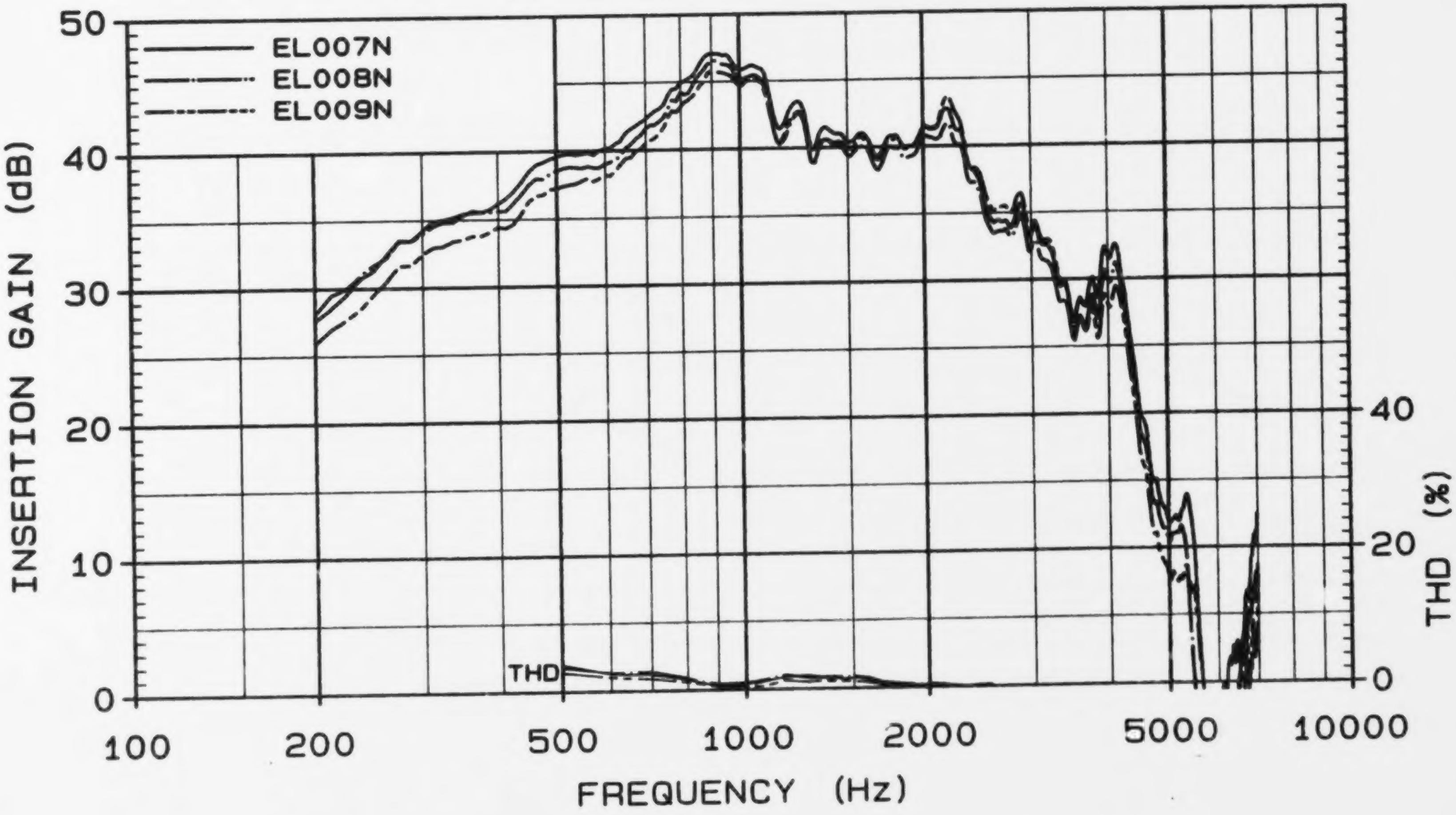
Average insertion gain (dB) in 20 bands (center frequencies shown)

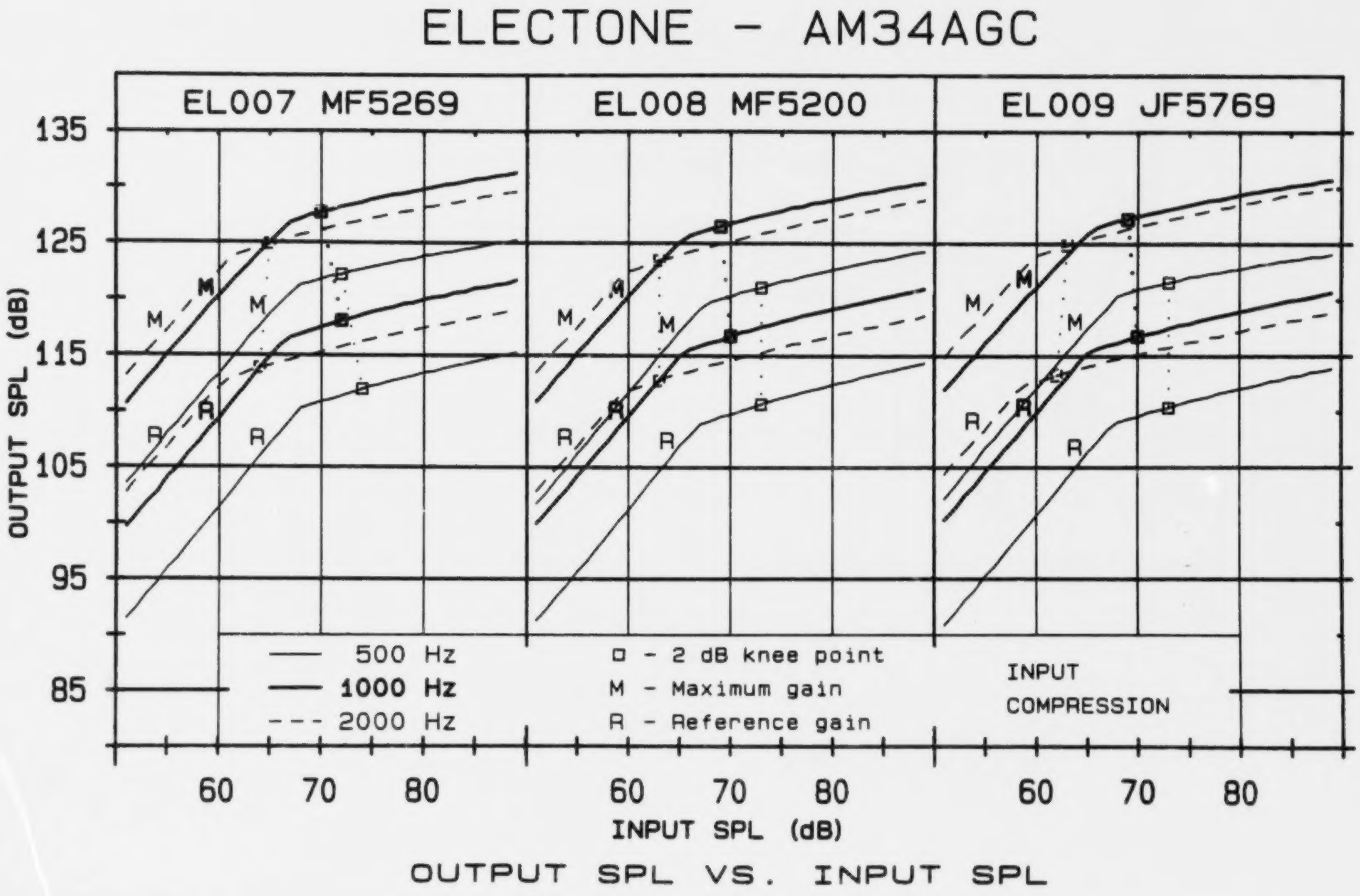
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
EL007	32	36	39.5	40.5	44	46.5	45.5	42.5	41	40.5
EL008	32	35.5	38	39.5	43	46	44.5	41.5	40	39.5
EL009	30	34	37	39	42.5	45.5	44.5	41.5	40	40

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
EL007	40	40.5	42	39.5	34.5	34	29.5	30.5	18.5	5
EL008	39.5	39.5	41	38.5	34	33	28	29	17	0.5
EL009	40	40.5	42.5	39.5	35.5	34.5	29	27.5	15	1

ts ts ts

ELECTONE - AM34AGC




ELECTONE - AM34AGC
EL007 MF5269
EL008 MF5200
EL009 JF5769
OUTPUT SPL (dB)
135
125
115
105
95
85
M
R
60
70
80
INPUT SPL (dB)
—— 500 Hz
—— 1000 Hz
- - - 2000 Hz
□ - 2 dB knee point
M - Maximum gain
R - Reference gain
INPUT
COMPRESSION
OUTPUT SPL VS. INPUT SPL

FIDELITY - 915H **HP**

SETTINGS - Tone:H
BATTERY - 13

NBS CODE	FI370	FI371	FI372
SERIAL NO.	03344	03347	03349
DATE TESTED	6/15/88	5/5/88	5/5/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	23	24.5	28.5
SSPL for shaped noise signal (dB)	121.5	121	122
with input spl (dB)	78	76	74
Induction coil output level (dB)			
Self noise	76.5	76	78
Vertical field- 10 mA/m	103.5	107.5	108
Lateral field- 10 mA/m	99.5	95	97.5
Longitud field- 10 mA/m	104	105	108
Calculated maximum	107.5	109.5	111
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	14.5	15.5	16
Equivalent input noise level (dB)	30.5	28.5	29
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	N.M.	1.35	1.35

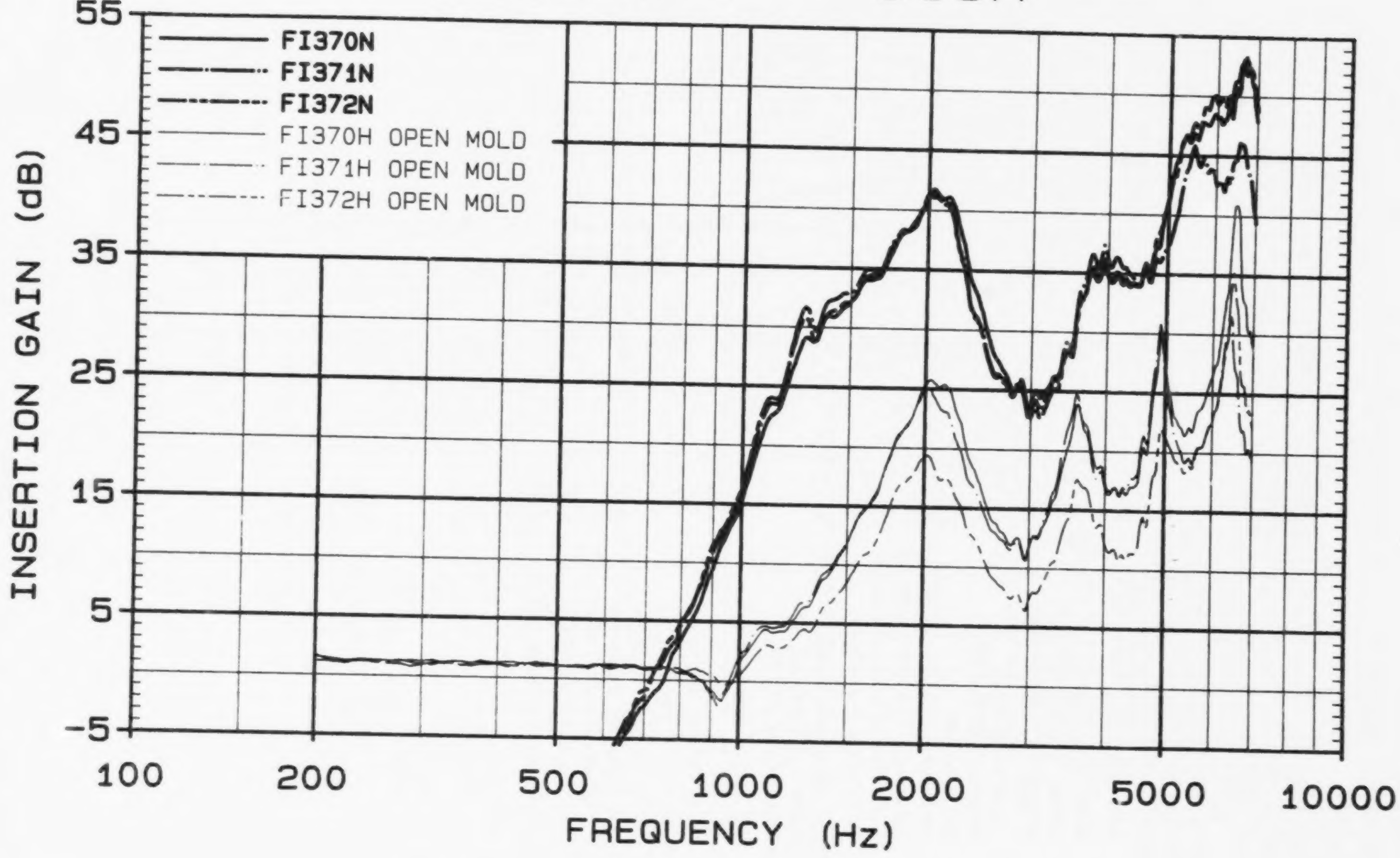
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
FI370	-27	-19.5	-13	-6	1.5	10.5	20	27	31	33.5
FI371	-21	-20.5	-11.5	-5.5	3	11.5	21	29	32	34
FI372	-22	-24	-11.5	-5	3	12	21.5	28.5	31	33.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
FI370	36.5	39.5	41	34.5	27.5	24.5	28.5	34.5	36	46.5
FI371	37	39.5	40.5	33	26.5	24.5	28.5	36	35.5	43
FI372	36.5	39.5	40	32.5	26	24	28	35	36.5	47

edb ts ts

FIDELITY - 915H



MAICO - M244VF CO

SETTINGS - POWER LIMITING:0 LOW:N
BATTERY - 675

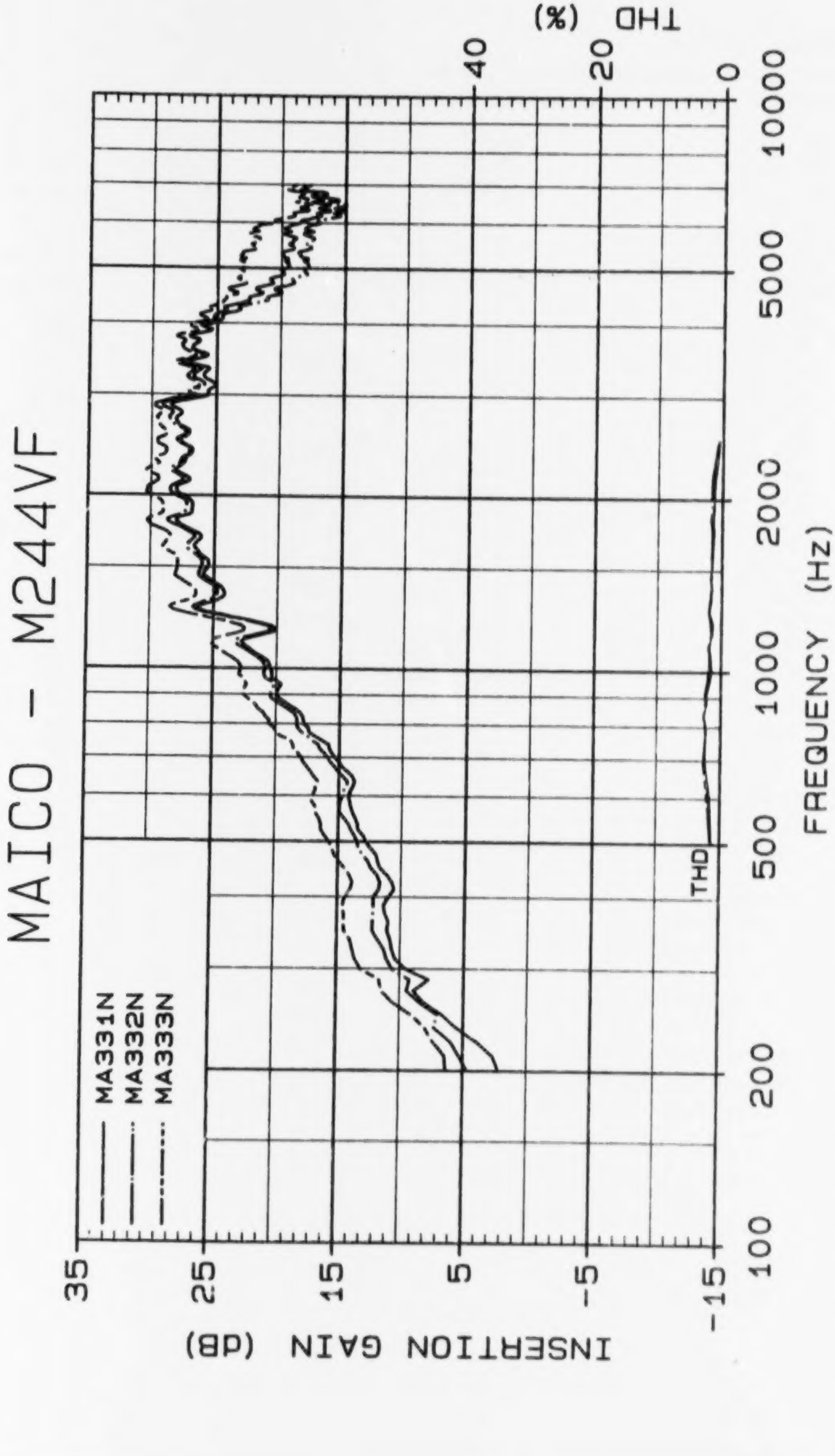
NBS CODE	MA331	MA332	MA333
SERIAL NO.	69043	69083	69086
DATE TESTED	5/10/88	5/10/88	5/10/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	34	34	39
SSPL for shaped noise signal (dB)	113.5	113.5	115
with input spl (dB)	72	76	78
Induction coil output level (dB)			
Self noise	62.5	62	67
Vertical field- 10 mA/m	88.5	88	99.5
Lateral field- 10 mA/m	83	81.5	93.5
Longitud field- 10 mA/m	96.5	95	100.5
Calculated maximum	97.5	96	103.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	20.5	21	25.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	1	1	2
800 Hz (%)	2	2	2
1600 Hz (%)	1	2	1
Maximum distortion above 800 Hz (%)	3	3	3
Freq. of max. (Hz)	830	830	830
Equivalent input noise level (dB)	27.5	27	27.5
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.32	1.32	1.32

Average insertion gain (dB) in 20 bands (center frequencies shown)

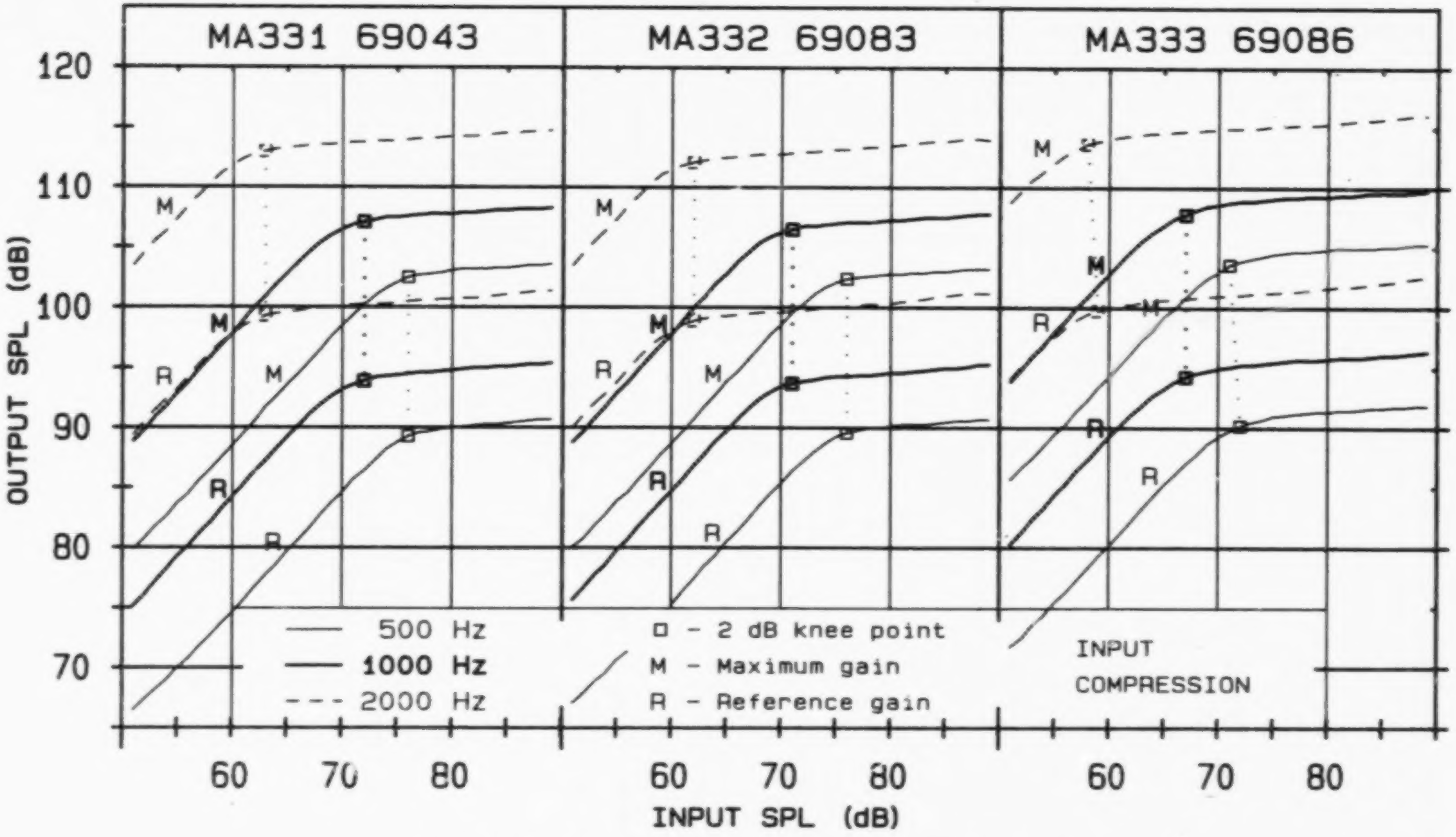
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
MA331	7	11	12.5	14	17	20	21.5	23	25	26
MA332	8.5	12	13.5	15	17.5	20.5	22	23.5	25.5	26.5
MA333	10	14.5	15.5	17	19.5	22.5	24	25.5	27	28.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
MA331	27	27	27.5	27.5	27.5	26.5	26.5	26	21.5	19.5
MA332	27.5	27.5	28	27.5	28	27.5	26.5	25.5	20	18
MA333	29.5	29.5	30	29.5	29.5	28	27.5	27	23.5	22.5

ts ts ts


MAICO - M244VF
MA331N
MA332N
MA333N
INSERTION GAIN (dB)
35
25
15
5
-5
-15
FREQUENCY (Hz)
100
200
500
1000
2000
5000
10000
THD (%)
40
20
0
THD

MAICO - M244VF



OUTPUT SPL VS. INPUT SPL

MAICO - MCO33VF CO

SETTINGS - POWER LIMITING:0 LOW:N
BATTERY - 675

NBS CODE	MA328	MA329	MA330
SERIAL NO.	11704	11905	11906
DATE TESTED	5/10/88	5/10/88	5/10/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	45.5	46	46
SSPL for shaped noise signal (dB)	125	126.5	127
with input spl (dB)	80	80	80
Induction coil output level (dB)			
Self noise	76	74.5	77
Vertical field- 10 mA/m	107.5	106	107
Lateral field- 10 mA/m	104	99.5	101.5
Longitud field- 10 mA/m	108	105	109
Calculated maximum	111.5	109	111.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	33.5	34.5	35
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	3	2	4
800 Hz (%)	3	2	3
1600 Hz (%)	2	1	1
Maximum distortion above 800 Hz (%)	4	3	3
Freq. of max. (Hz)	1270	1270	830
Equivalent input noise level (dB)	23.5	22.5	22
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.32	1.32	1.32

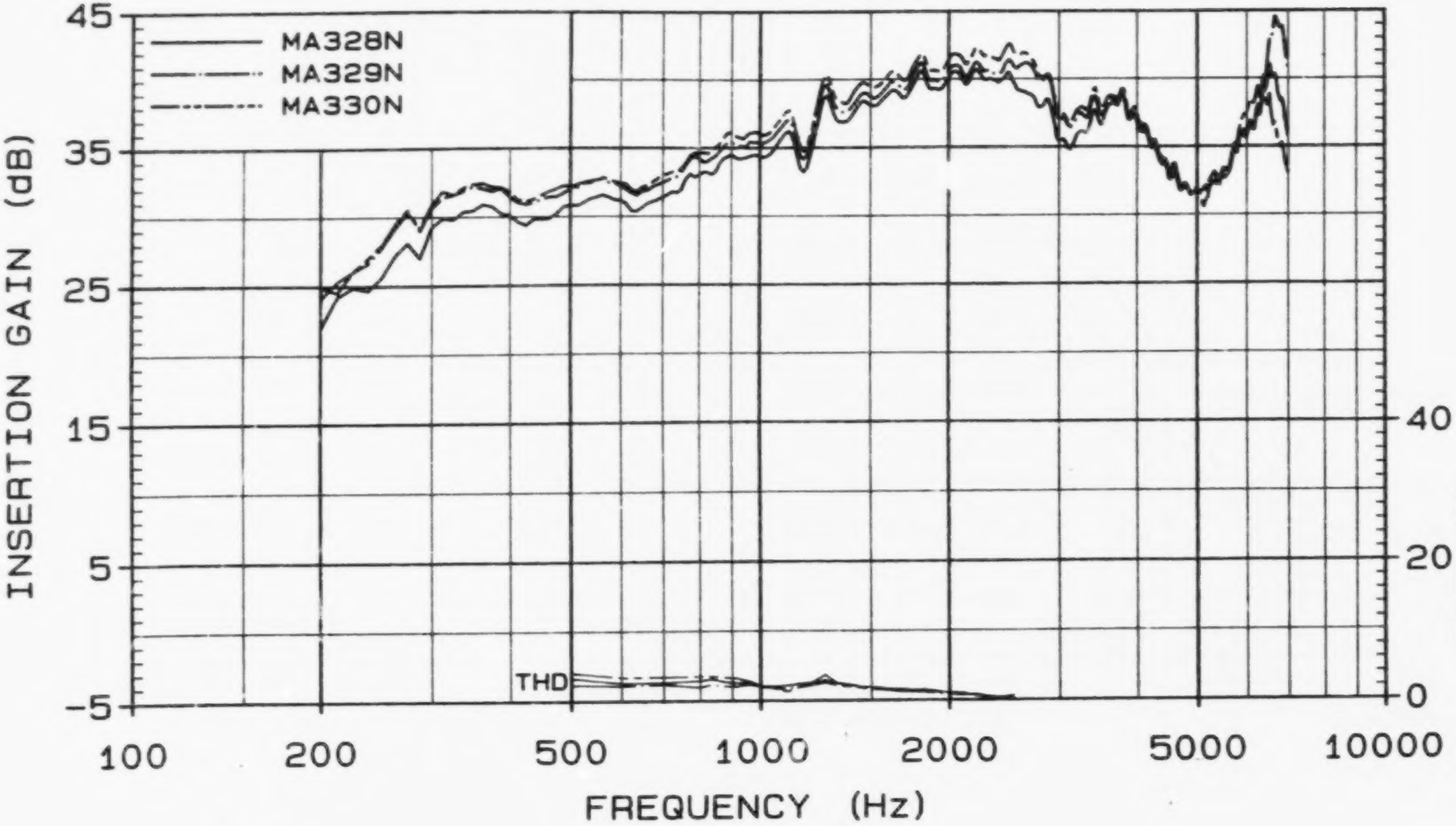
Average insertion gain (dB) in 20 bands (center frequencies shown)

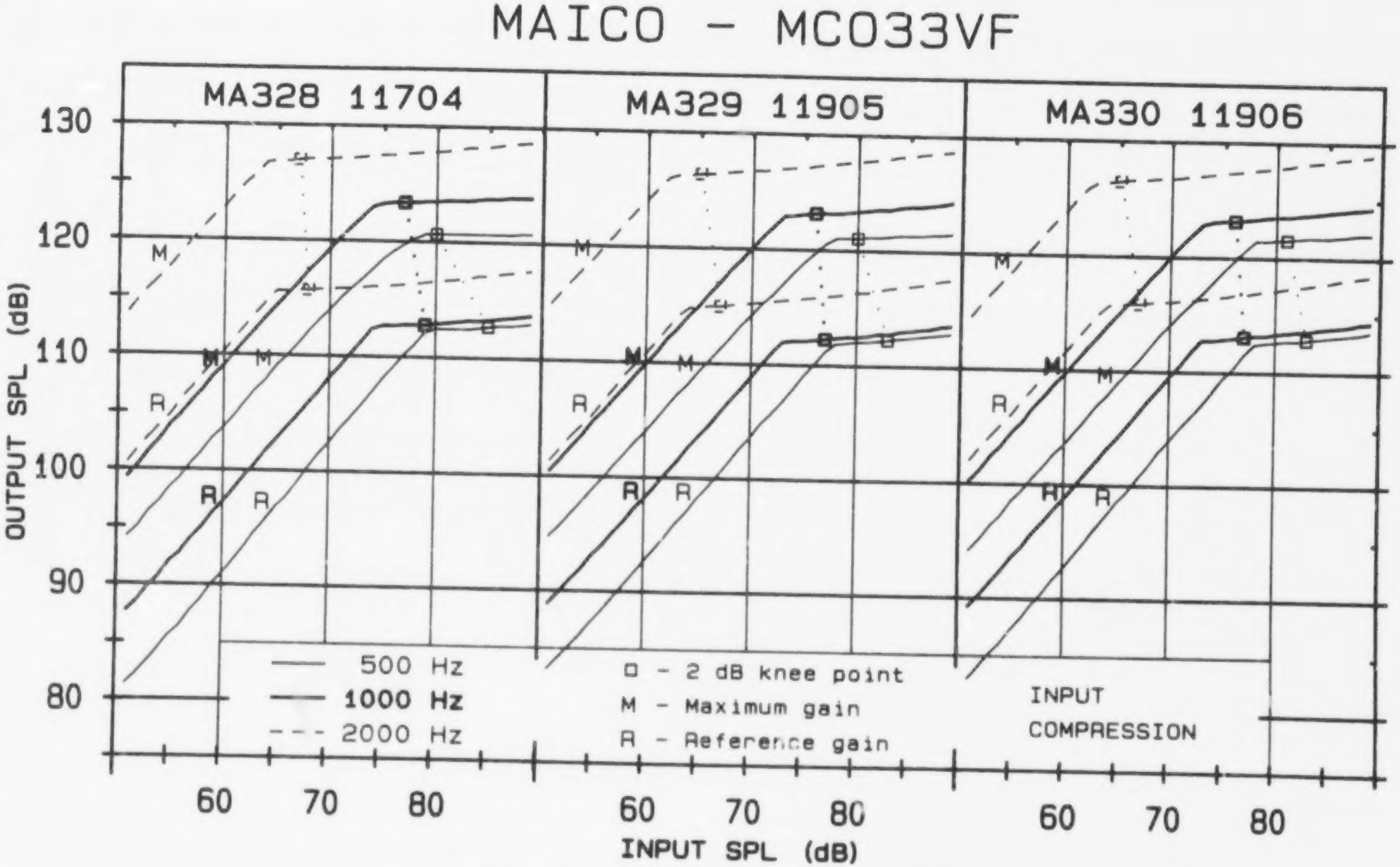
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
MA328	26.5	30	30.5	31	32.5	34	35	36	37.5	38.5
MA329	28.5	31.5	32	32	33.5	35	36	37	38	39
MA330	28.5	32	32	32.5	34	36	37	37.5	39	40

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
MA328	39.5	39.5	40.5	40	39	36.5	37	37	33	33.5
MA329	40	40	41	40.5	41	38	38	37.5	33	33.5
MA330	41	41	41.5	42	41.5	38.5	38.5	37.5	33	33.5

ts ts ts

MAICO - MC033VF





OUTPUT SPL VS. INPUT SPL

MAICO - MC034VF **CO**

SETTINGS - POWER LIMITING:0 LOW:N
BATTERY - 675

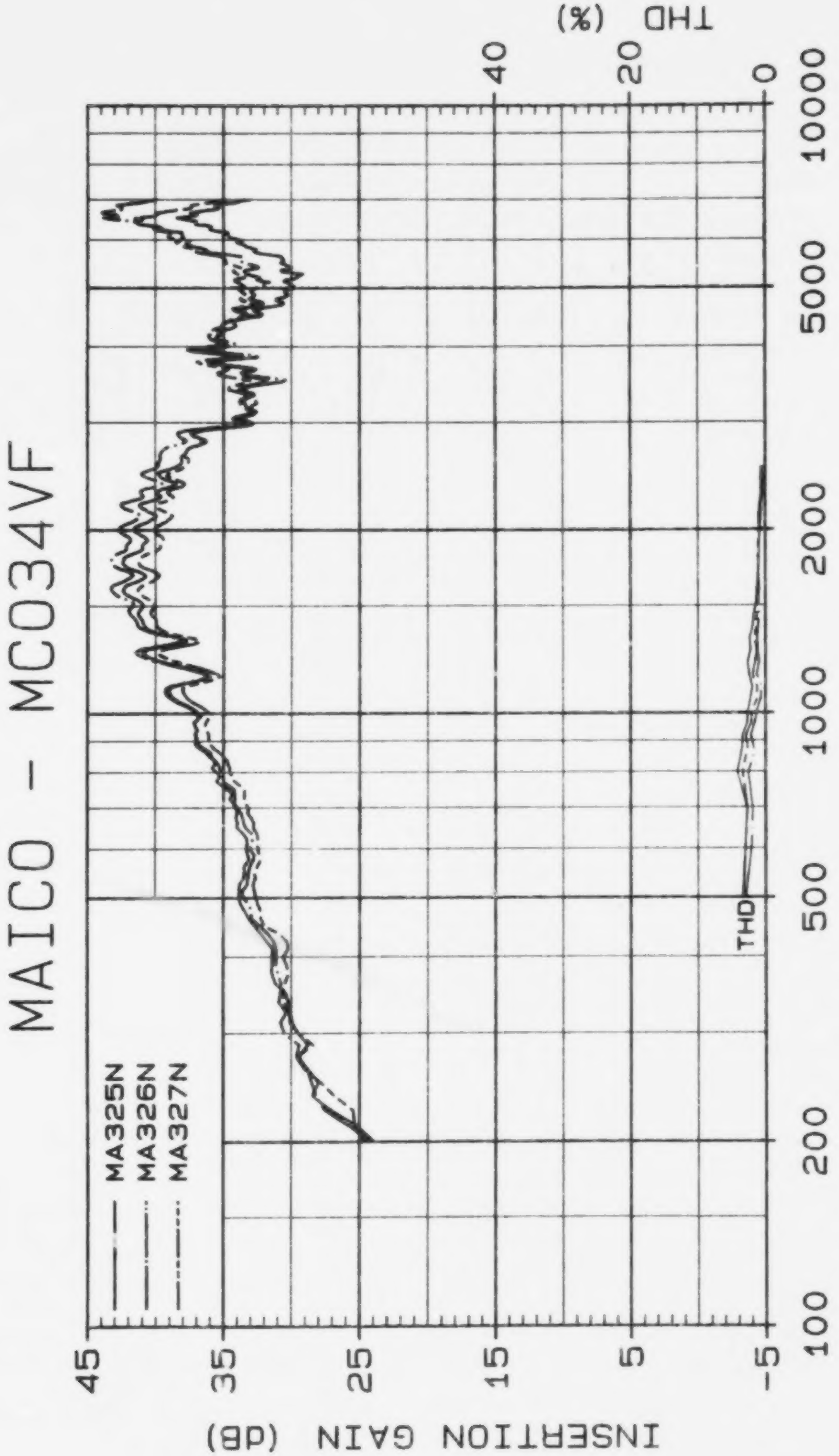
NBS CODE	MA325	MA326	MA327
SERIAL NO.	10302	11983	11986
DATE TESTED	5/10/88	5/10/88	5/10/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	41.5	43	43.5
SSPL for shaped noise signal (dB)	124.5	126	124
with input spl (dB)	82	80	82
Induction coil output level (dB)			
Self noise	76.5	76	76
Vertical field- 10 mA/m	105.5	101	105.5
Lateral field- 10 mA/m	99	97.5	103
Longitud field- 10 mA/m	107	109	104
Calculated maximum	110	110	109
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	36	36	35
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	3	3	3
800 Hz (%)	4	3	3
1600 Hz (%)	1	1	1
Maximum distortion above 800 Hz (%)	4	2	3
Freq. of max. (Hz)	830	920	830
Equivalent input noise level (dB)	27	25.5	26
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.32	1.32	1.32

Average insertion gain (dB) in 20 bands (center frequencies shown)

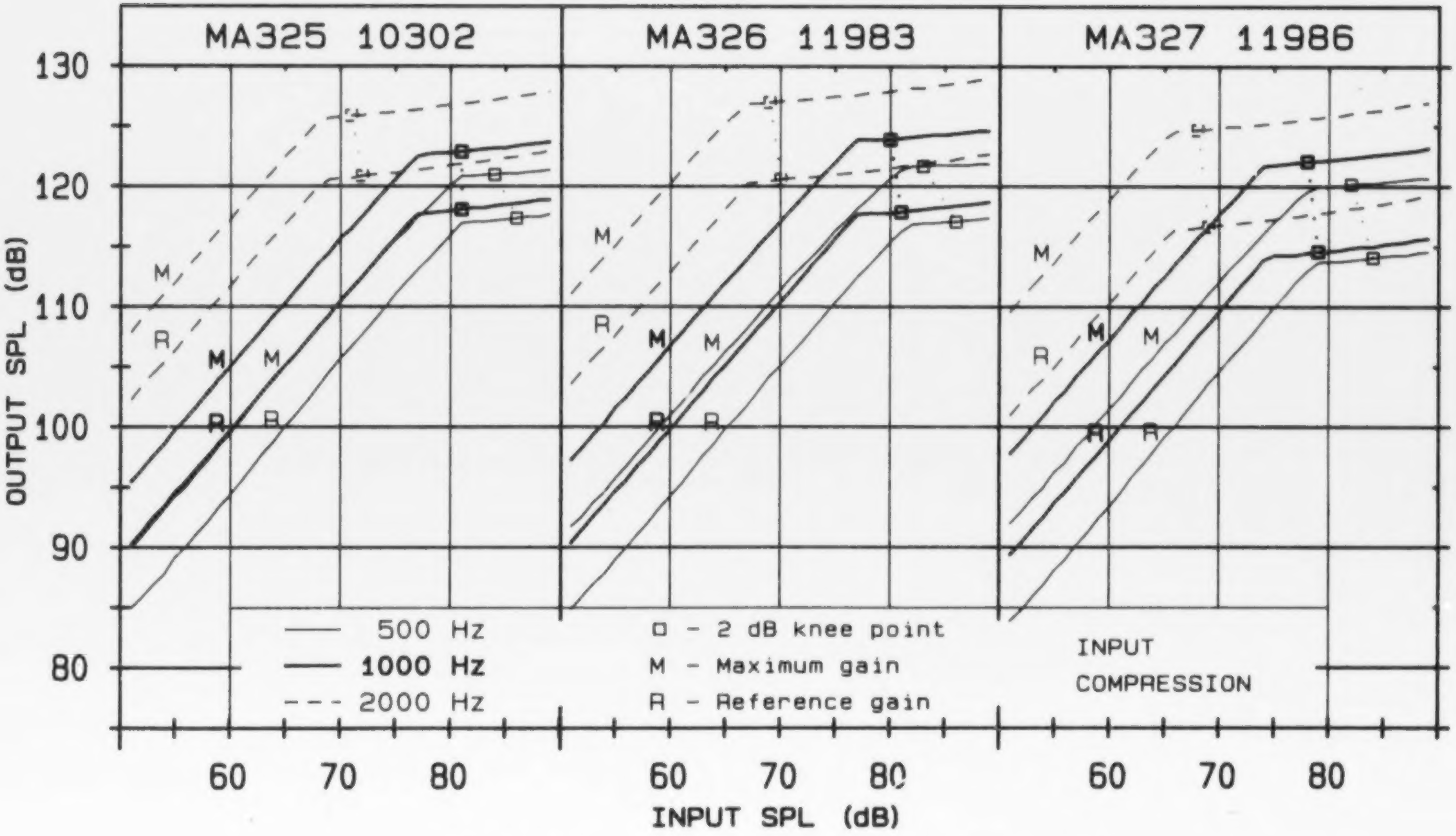
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
MA325	28	31	33.5	33.5	35	37	38	39	40	41.5
MA326	28.5	31	33	33	34.5	37	38.5	39.5	40.5	42.5
MA327	28	30.5	32.5	32.5	34	36	37	38	39.5	40.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
MA325	41.5	41	40.5	39.5	38	34.5	33	35	32	31
MA326	42.5	42	42	40.5	39.5	35	32.5	34.5	33.5	34.5
MA327	40.5	40	39.5	38.5	37.5	34.5	34	35.5	34	35.5

ts ts ts


MAICO - MC034VF
MA325N
MA326N
MA327N
THD
INSERTION GAIN (dB)
45
35
25
15
5
-5
THD (%)
40
20
0
FREQUENCY (Hz)
100
200
500
1000
2000
5000
10000

MAICO - MC034VF



OUTPUT SPL VS. INPUT SPL

MAICO - SP137VF **ASP**

SETTINGS - Gain:45 Output:Max Tone:N
BATTERY - 675

NBS CODE	MA334	MA335	MA336
SERIAL NO.	11632	11634	12021
DATE TESTED	7/7/88	7/8/88	7/8/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	40	45	42.5
SSPL for shaped noise signal (dB)	122.5	123	122.5
with input spl (dB)	78	72	74
Induction coil output level (dB)			
Self noise	65.5	62	66
Vertical field- 10 mA/m	78.5	81	77
Lateral field- 10 mA/m	93	90	92
Longitud field- 10 mA/m	101.5	97	100
Calculated maximum	102	98	100.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	36	37	35.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	4	6	2
800 Hz (%)	5	4	2
1600 Hz (%)	2	2	1
Maximum distortion above 800 Hz (%)	5	6	4
Freq. of max. (Hz)	830	2200	2200
Equivalent input noise level (dB)	25.5	22.5	24.5
Battery drain (mA)			
No input signal	1.2	1.2	1.2
With shaped input noise level-65dB	1.5	1.4	1.3
Battery voltage (V)	1.31	1.32	1.31

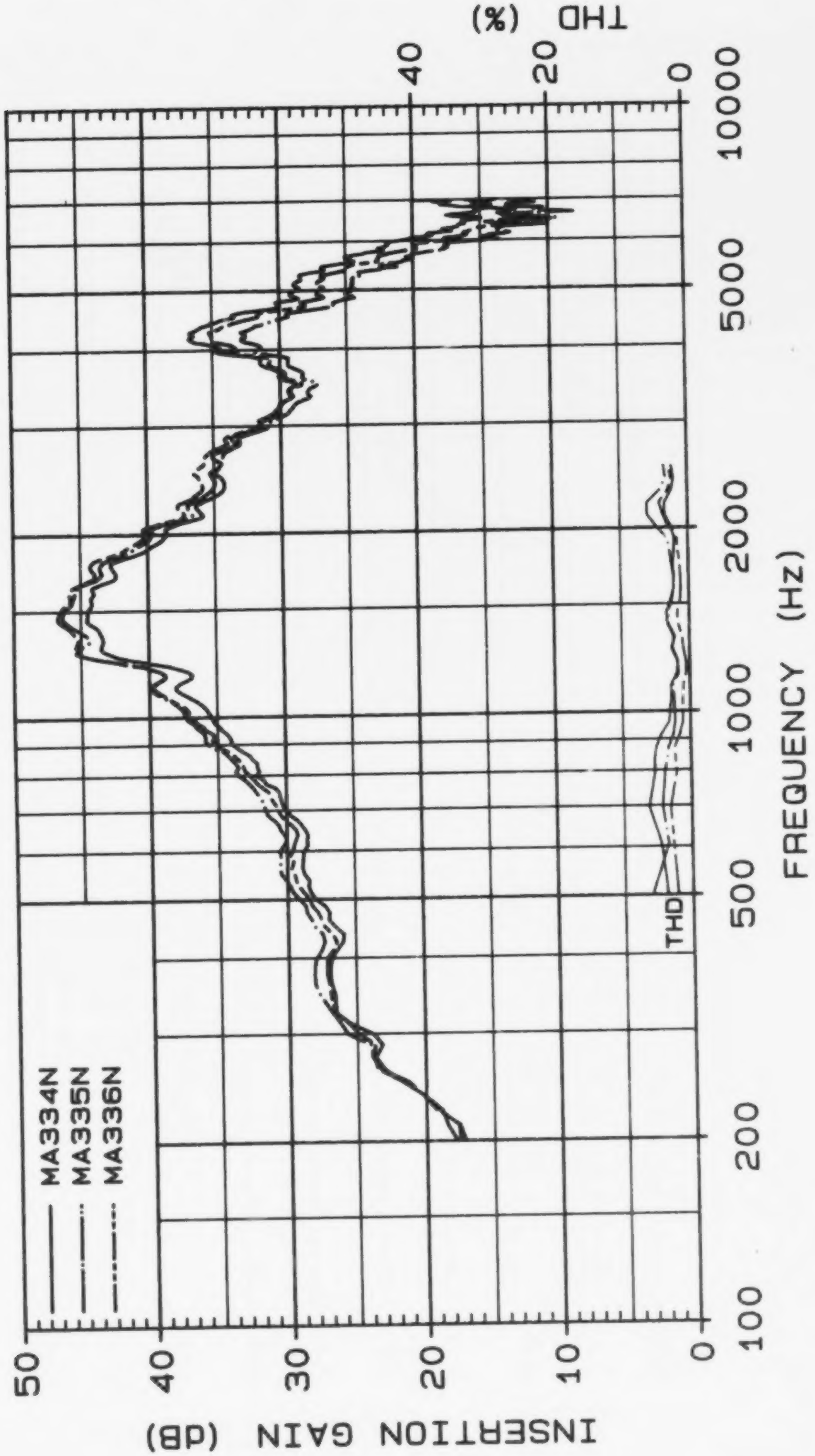
Average insertion gain (dB) in 20 bands (center frequencies shown)

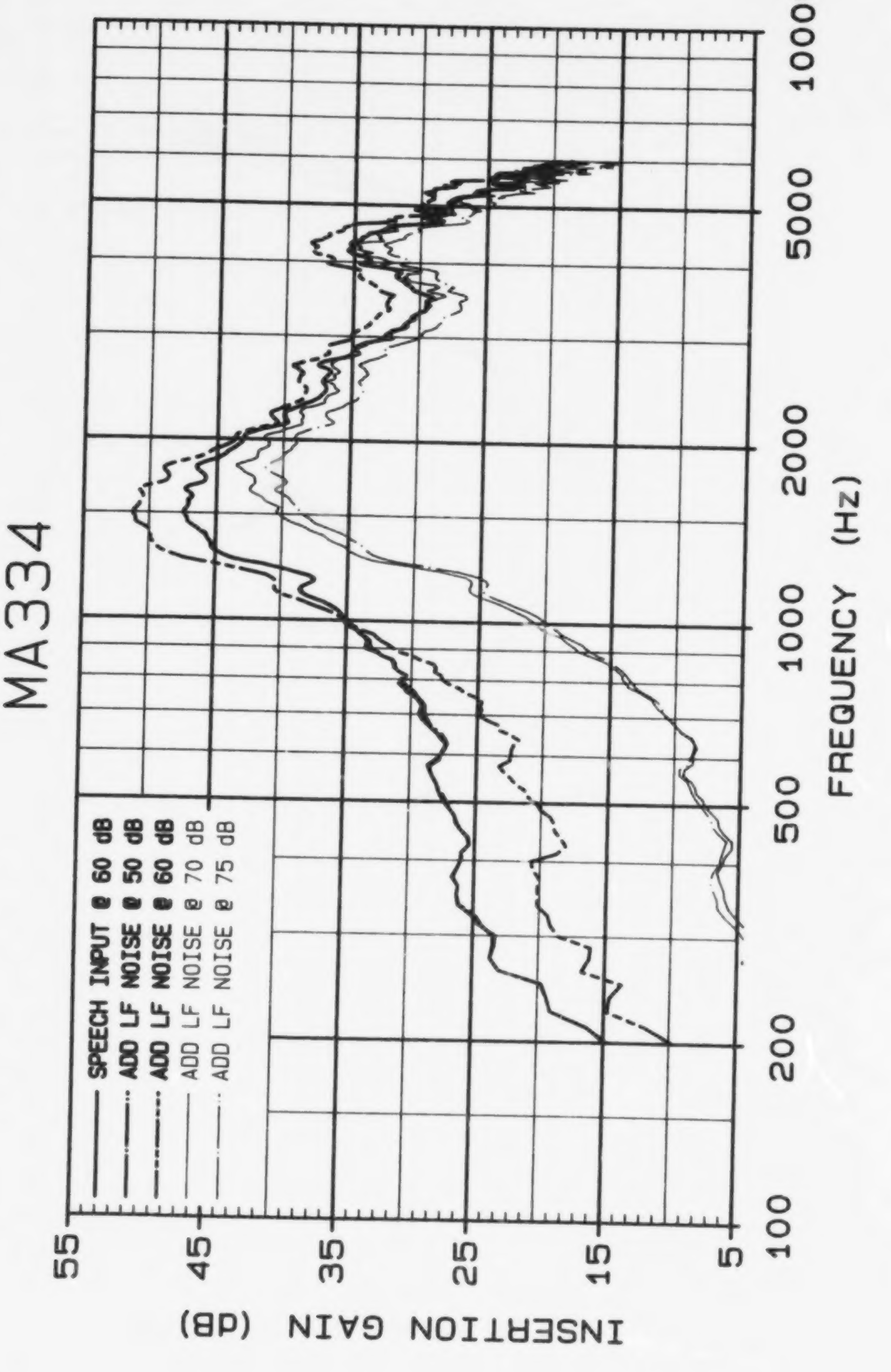
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
MA334	22	26.5	27.5	29	31	34	37	40	44	44
MA335	22.5	28	29	30.5	32.5	35.5	38.5	42	45.5	45.5
MA336	22	27	28.5	29.5	32	35	38.5	42	46	46

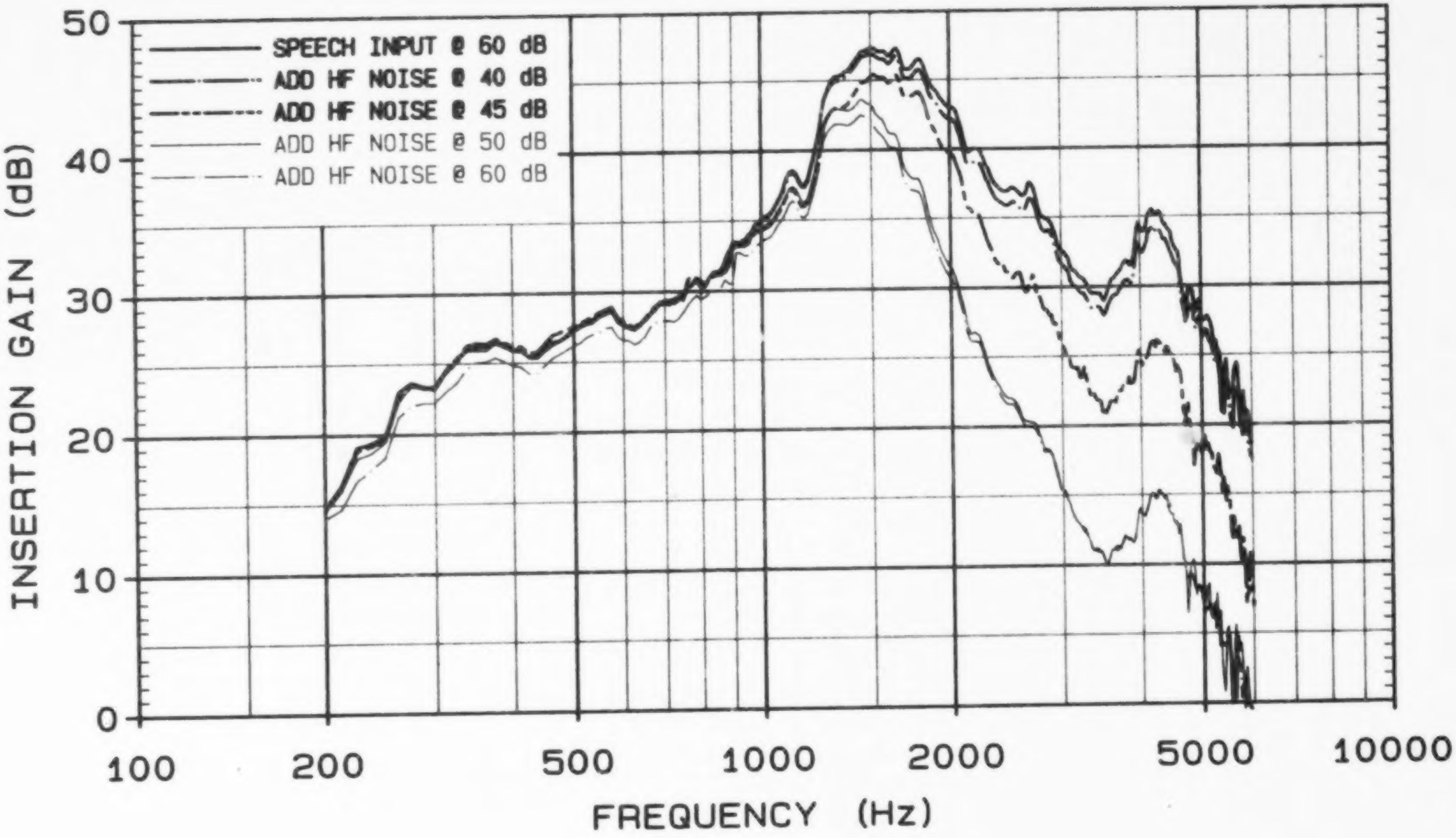
Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
MA334	42.5	39.5	37	34.5	34.5	32	29.5	33.5	32	25.5
MA335	43.5	40.5	37.5	35.5	34.5	31	28	30.5	28	21.5
MA336	44	41	38.5	36	35.5	32	29.5	32.5	30.5	23.5

edb edb edb

MAICO - SP137VF




MA334
SPEECH INPUT @ 60 dB
ADD LF NOISE @ 50 dB
ADD LF NOISE @ 60 dB
ADD LF NOISE @ 70 dB
ADD LF NOISE @ 75 dB
INSERTION GAIN (dB)
55
45
35
25
15
5
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)


MA334

SPEECH INPUT @ 60 dB
ADD HF NOISE @ 40 dB
ADD HF NOISE @ 45 dB
ADD HF NOISE @ 50 dB
ADD HF NOISE @ 60 dB
INSERTION GAIN (dB)
0
10
20
30
40
50
FREQUENCY (Hz)
100
200
500
1000
2000
5000
10000

MAICO - SP335VF ASP

SETTINGS - Gain:63 Output:Max Tone:N
BATTERY - 675

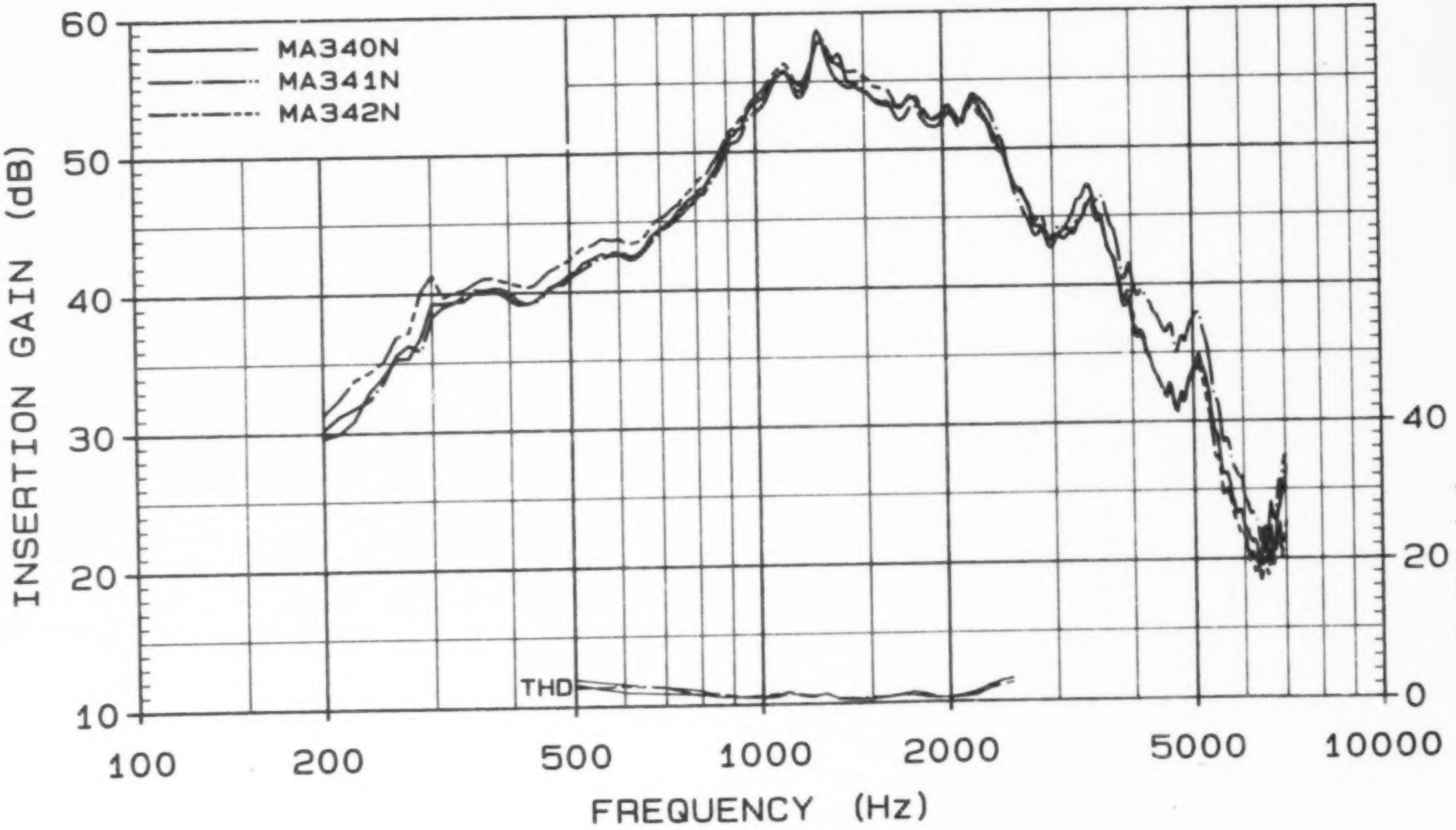
NBS CODE	MA340	MA341	MA342
SERIAL NO.	10445	10716	10774
DATE TESTED	7/11/88	7/11/88	7/11/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	64	62	64
SSPL for shaped noise signal (dB)	135.5	135.5	136
with input spl (dB)	68	68	70
Induction coil output level (dB)			
Self noise	76.5	74.5	74
Vertical field- 10 mA/m	85.5	95.5	99
Lateral field- 10 mA/m	101.5	103.5	104
Longitud field- 10 mA/m	109.5	113	114
Calculated maximum	110.5	113.5	114.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	53	52.5	53.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	3	4	3
800 Hz (%)	2	2	1
1600 Hz (%)	1	1	1
Maximum distortion above 800 Hz (%)	3	3	3
Freq. of max. (Hz)	2530	2530	2530
Equivalent input noise level (dB)	20	21.5	18
Battery drain (mA)			
No input signal	1.2	1.1	1.1
With shaped input noise level-65dB	3.5	3.1	3.2
Battery voltage (V)	1.33	1.32	1.32

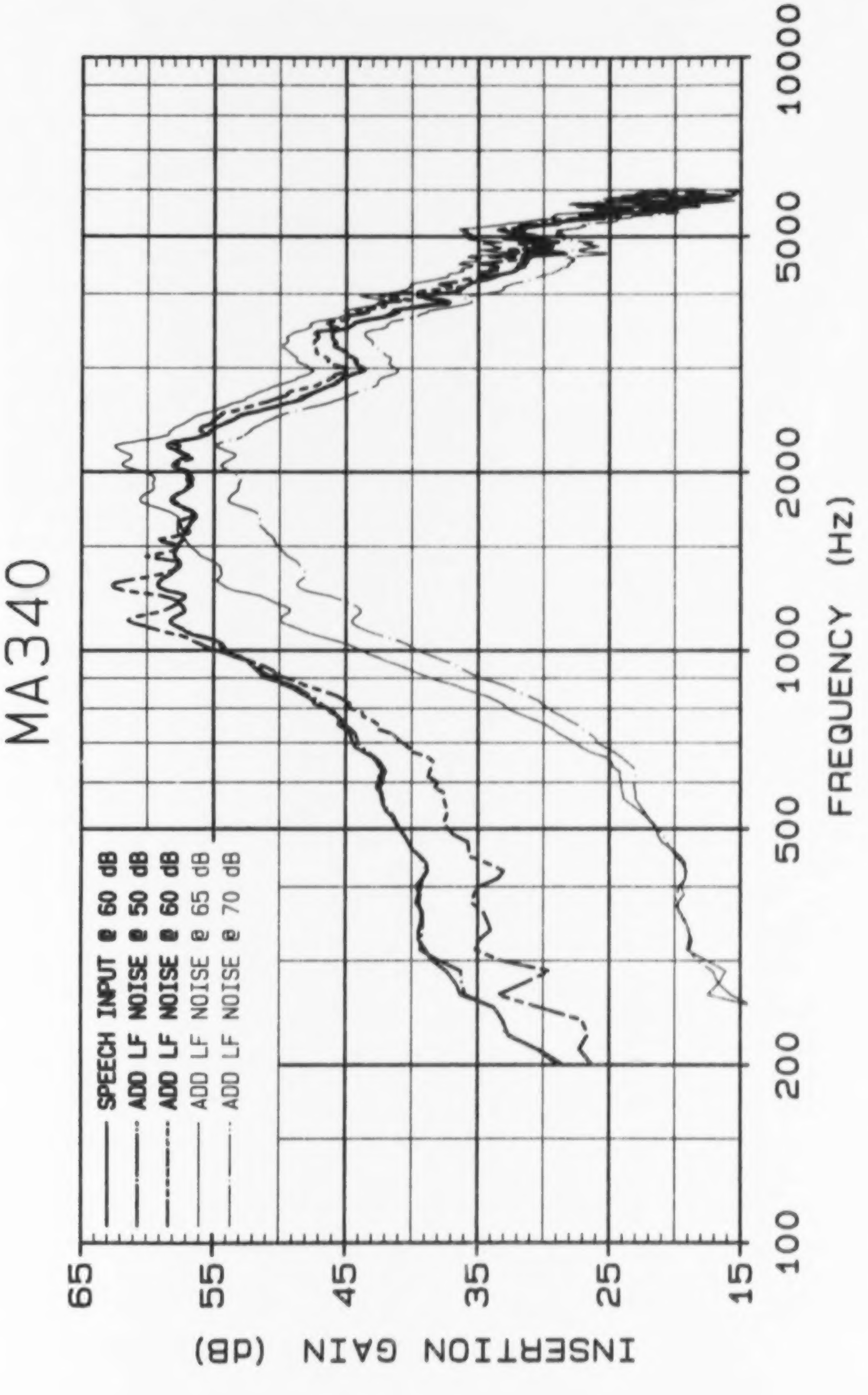
Average insertion gain (dB) in 20 bands (center frequencies shown)

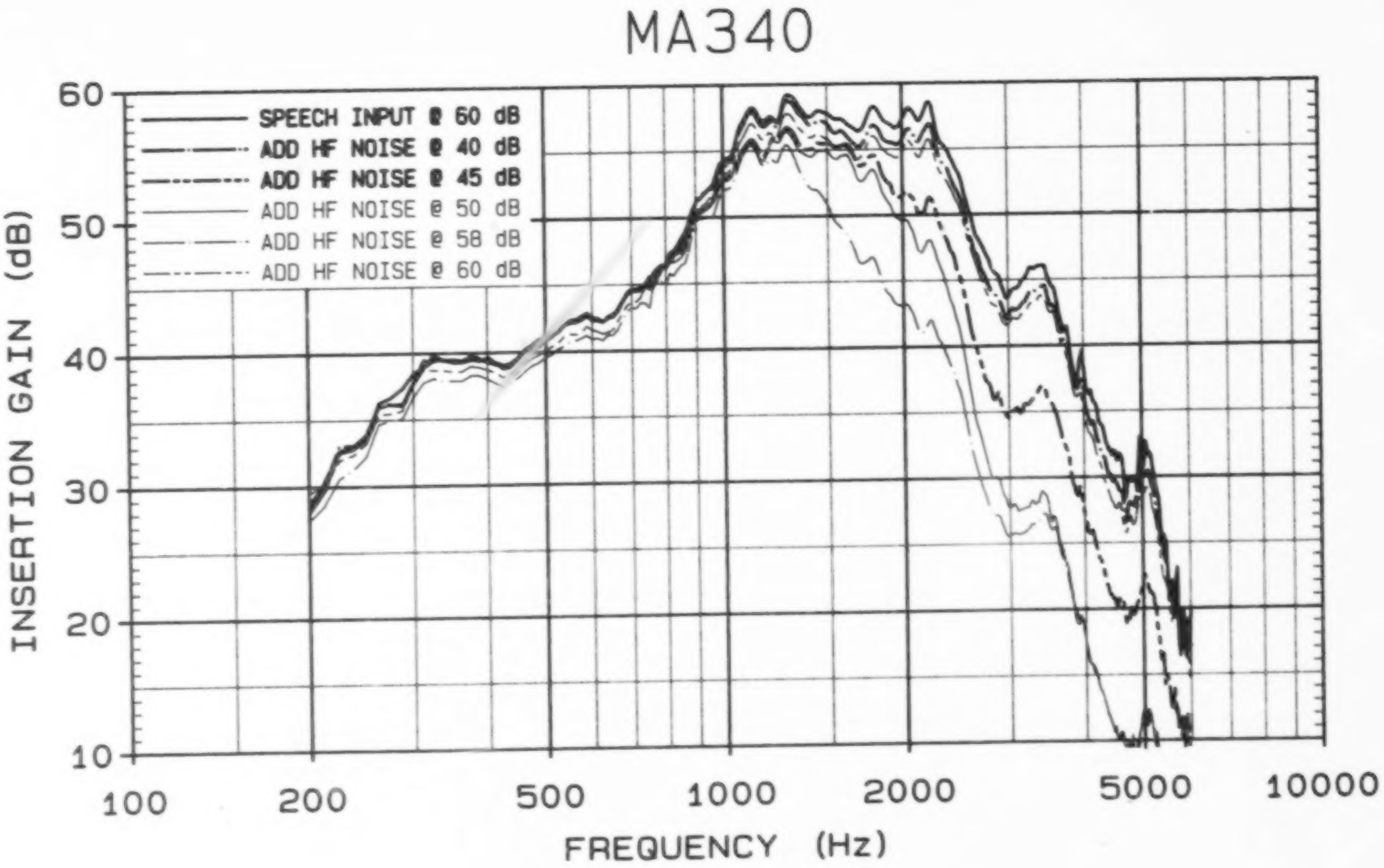
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
MA340	35	39.5	41	43	46	51	55	56	55	53.5
MA341	35	40	41	43	46	50.5	54.5	56	56	53.5
MA342	36.5	40.5	42	44	47	51.5	55.5	56.5	56	54.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
MA340	53.5	52.5	53	52	47	44	46	38.5	32.5	28
MA341	52.5	52	52.5	52.5	46	44	45.5	41	37	31
MA342	53.5	52.5	52.5	51.5	47	44	45	39	32.5	27
								edb	edb	edb

MAICO - SP335VF




MA340
SPEECH INPUT @ 60 dB
ADD LF NOISE @ 50 dB
ADD LF NOISE @ 60 dB
ADD LF NOISE @ 65 dB
ADD LF NOISE @ 70 dB
INSERTION GAIN (dB)
65
55
45
35
25
15
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)


MA340
SPEECH INPUT @ 60 dB
ADD HF NOISE @ 40 dB
ADD HF NOISE @ 45 dB
ADD HF NOISE @ 50 dB
ADD HF NOISE @ 58 dB
ADD HF NOISE @ 60 dB
INSERTION GAIN (dB)
60
50
40
30
20
10
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

MAICO - SP345VF ASP

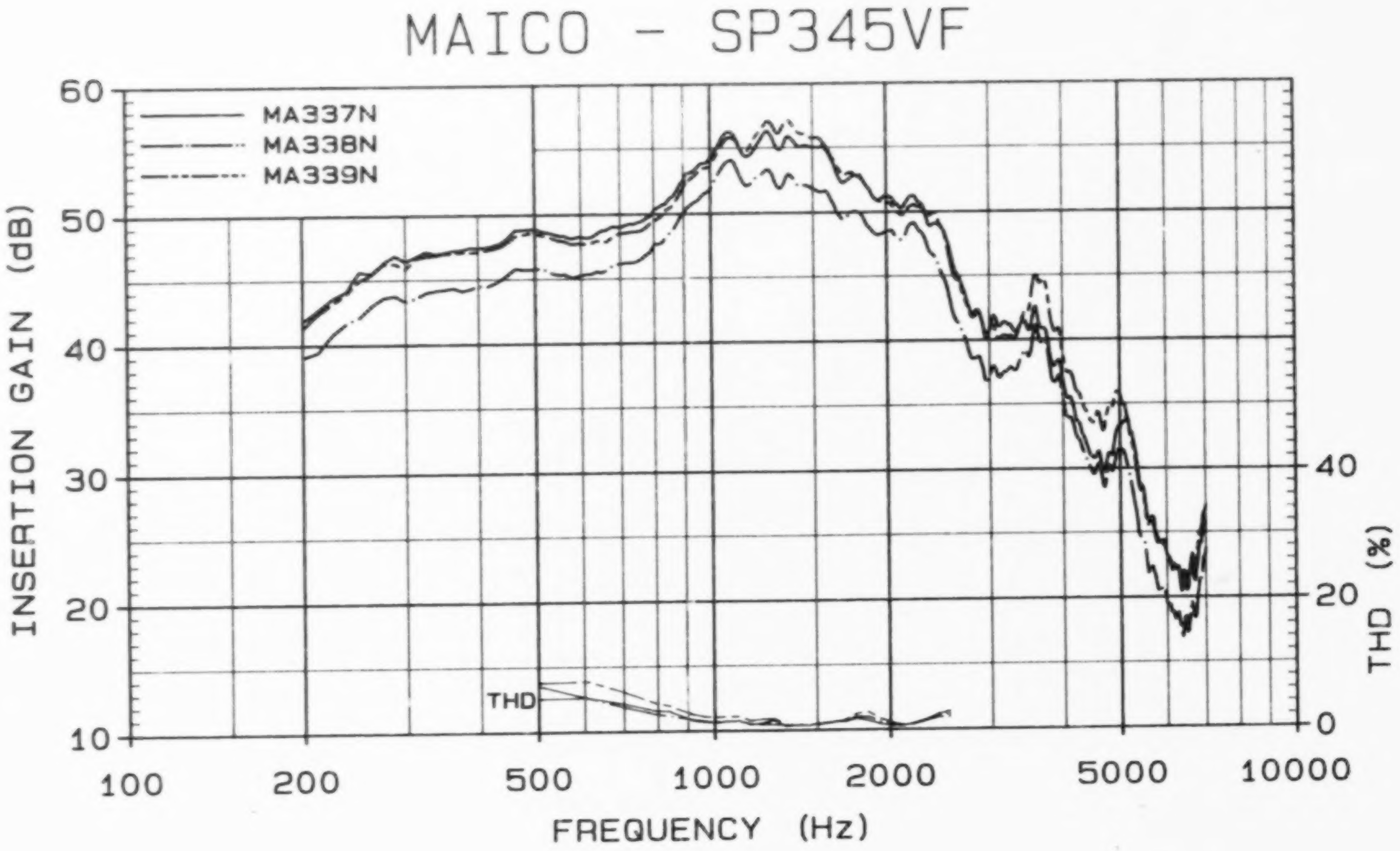
SETTINGS - Gain:68 Output:Max Tone:N
BATTERY - 675

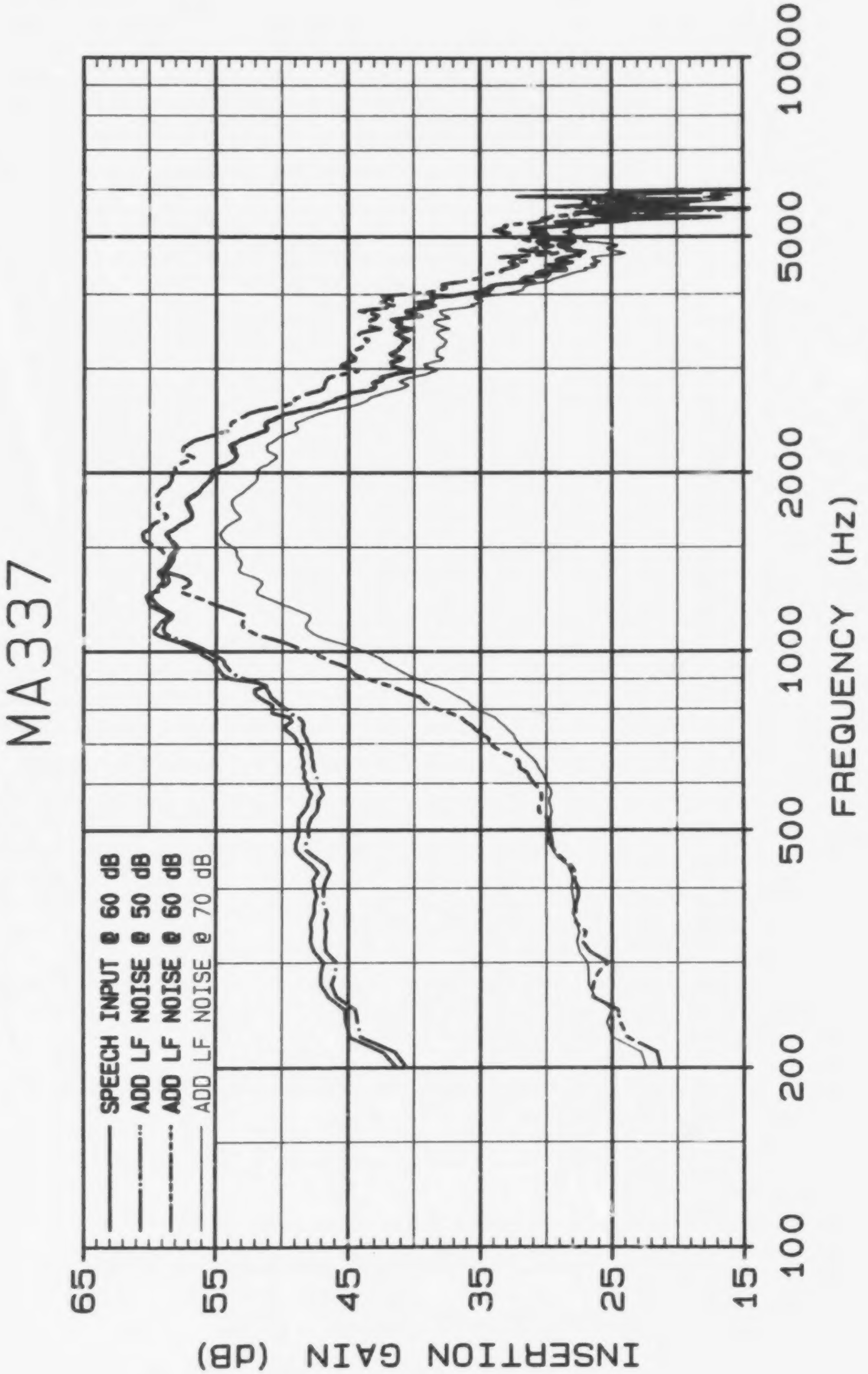
NBS CODE	MA337	MA338	MA339
SERIAL NO.	10519	11568	11605
DATE TESTED	7/8/88	7/8/88	7/11/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	65	68.5	69.5
SSPL for shaped noise signal (dB)	135	132.5	135.5
with input spl (dB)	70	62	66
Induction coil output level (dB)			
Self noise	76.5	83.5	79.5
Vertical field- 10 mA/m	77	86.5	92
Lateral field- 10 mA/m	100	105.5	106.5
Longitud field- 10 mA/m	109.5	113	114
Calculated maximum	110	113.5	114.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	53.5	51.5	53.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	7	5	8
800 Hz (%)	3	3	4
1600 Hz (%)	1	1	1
Maximum distortion above 800 Hz (%)	3	2	4
Freq. of max. (Hz)	830	830	830
Equivalent input noise level (dB)	19	17.5	18
Battery drain (mA)			
No input signal	1.5	1.2	1.3
With shaped input noise level-65dB	4.0	3.0	3.6
Battery voltage (V)	1.32	1.32	1.32

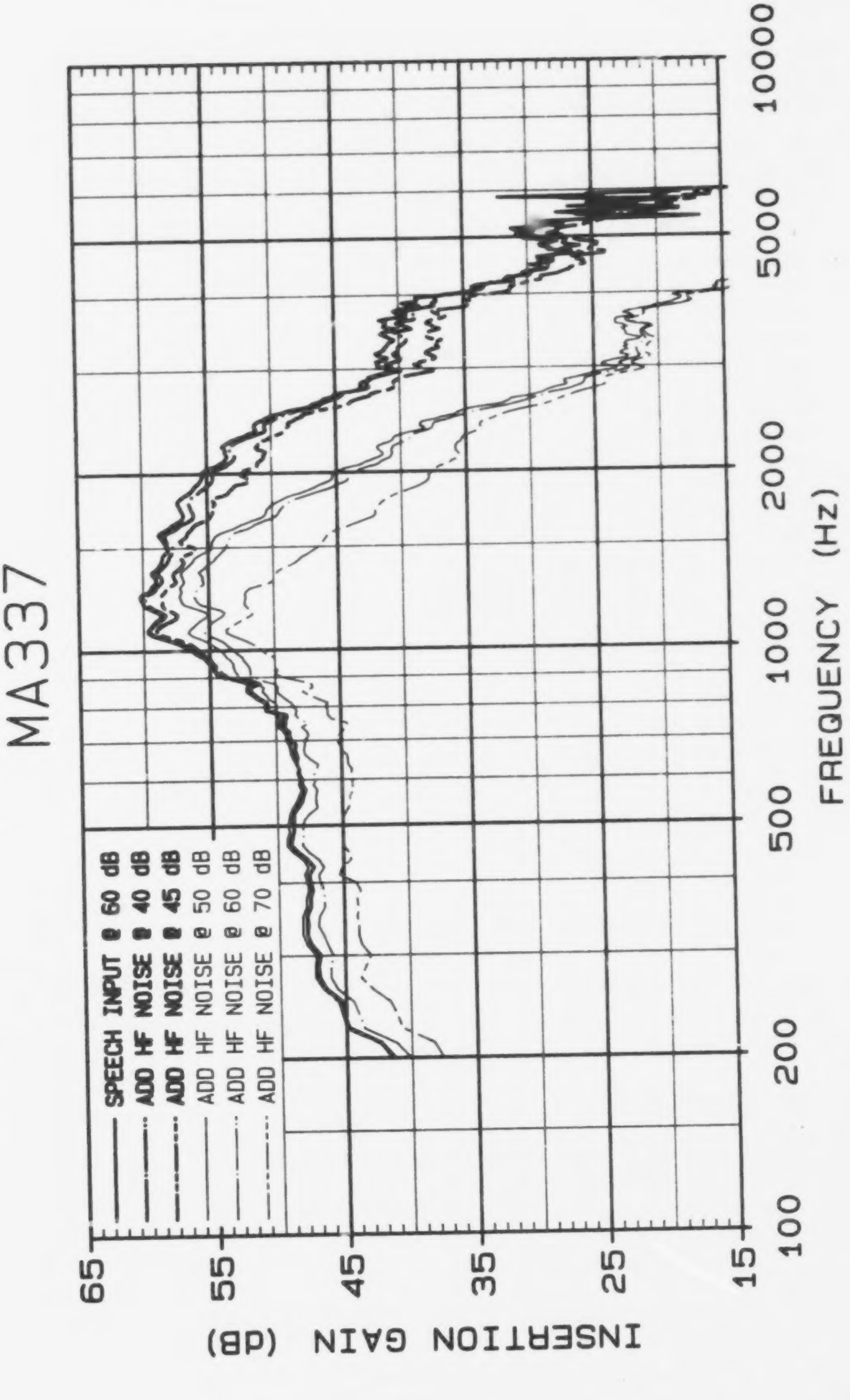
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
MA337	45	47.5	48.5	48.5	50	53	55.5	55.5	55.5	54.5
MA338	42.5	44.5	45.5	45.5	47	50.5	53	52.5	52.5	51.5
MA339	45	47	48	48	49	52.5	55	56	56.5	55

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
MA337	52.5	51.5	51	49.5	45	41.5	41.5	37.5	31.5	28.5
MA338	50	48.5	48.5	47	41.5	37.5	39	36.5	30.5	24.5
MA339	53	51	50	50	44.5	41	42	40	34.5	28
							edb	edb	edb	


MAICO - SP345VF
MA337N
MA338N
MA339N
INSERTION GAIN (dB)
60
50
40
30
20
10
THD
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)
40
20
0
THD (%)


MA337
SPEECH INPUT @ 60 dB
ADD LF NOISE @ 50 dB
ADD LF NOISE @ 60 dB
ADD LF NOISE @ 70 dB
INSERTION GAIN (dB)
65
55
45
35
25
15
FREQUENCY (Hz)
100
200
500
1000
2000
5000
10000


MA337
INSERTION GAIN (dB)
65
55
45
35
25
15
FREQUENCY (Hz)
100
200
500
1000
2000
5000
10000
SPEECH INPUT @ 60 dB
ADD HF NOISE @ 40 dB
ADD HF NOISE @ 45 dB
ADD HF NOISE @ 50 dB
ADD HF NOISE @ 60 dB
ADD HF NOISE @ 70 dB

OTICON - E25P **CO**

SETTINGS - A-GRAM:3.1 dBHL:90 AGC:5 VC:4
BATTERY - 675

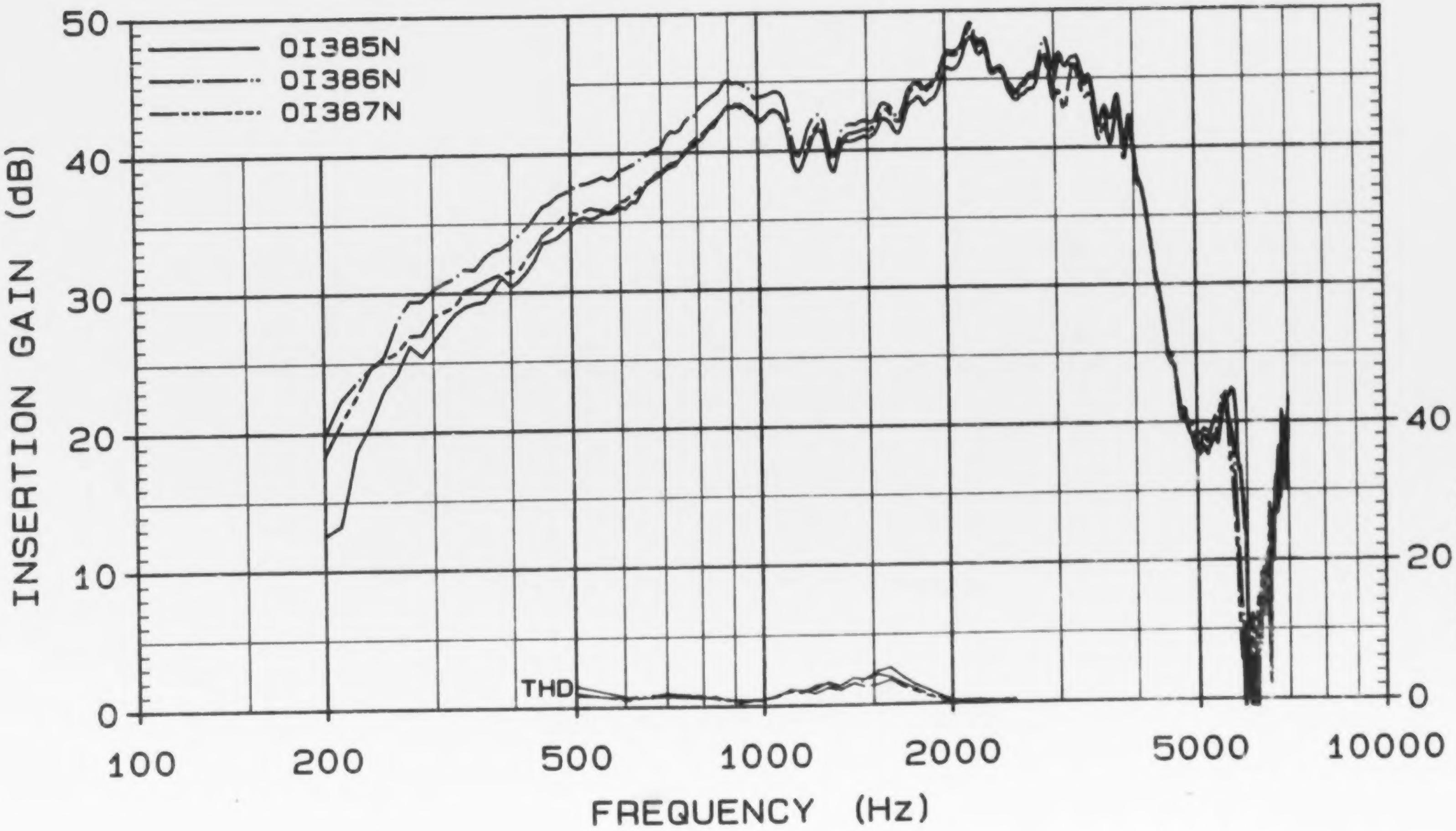
NBS CODE	OI385	OI386	OI387
SERIAL NO.	039461	039463	039629
DATE TESTED	5/13/88	5/13/88	5/13/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	46	49	48.5
SSPL for shaped noise signal (dB)	132	132	131.5
with input spl (dB)	76	74	72
Induction coil output level (dB)			
Self noise	82	82.5	82.5
Vertical field- 10 mA/m	104	105.5	107
Lateral field- 10 mA/m	88.5	93	93
Longitud field- 10 mA/m	86	84	84.5
Calculated maximum	104.5	106	107.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	41	42.5	41
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	2	3	2
800 Hz (%)	1	1	2
1600 Hz (%)	5	4	4
Maximum distortion above 800 Hz (%)	5	4	4
Freq. of max. (Hz)	1590	1520	1590
Equivalent input noise level (dB)	29	28	28
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.35	1.35	1.35

Average insertion gain (dB) in 20 bands (center frequencies shown)

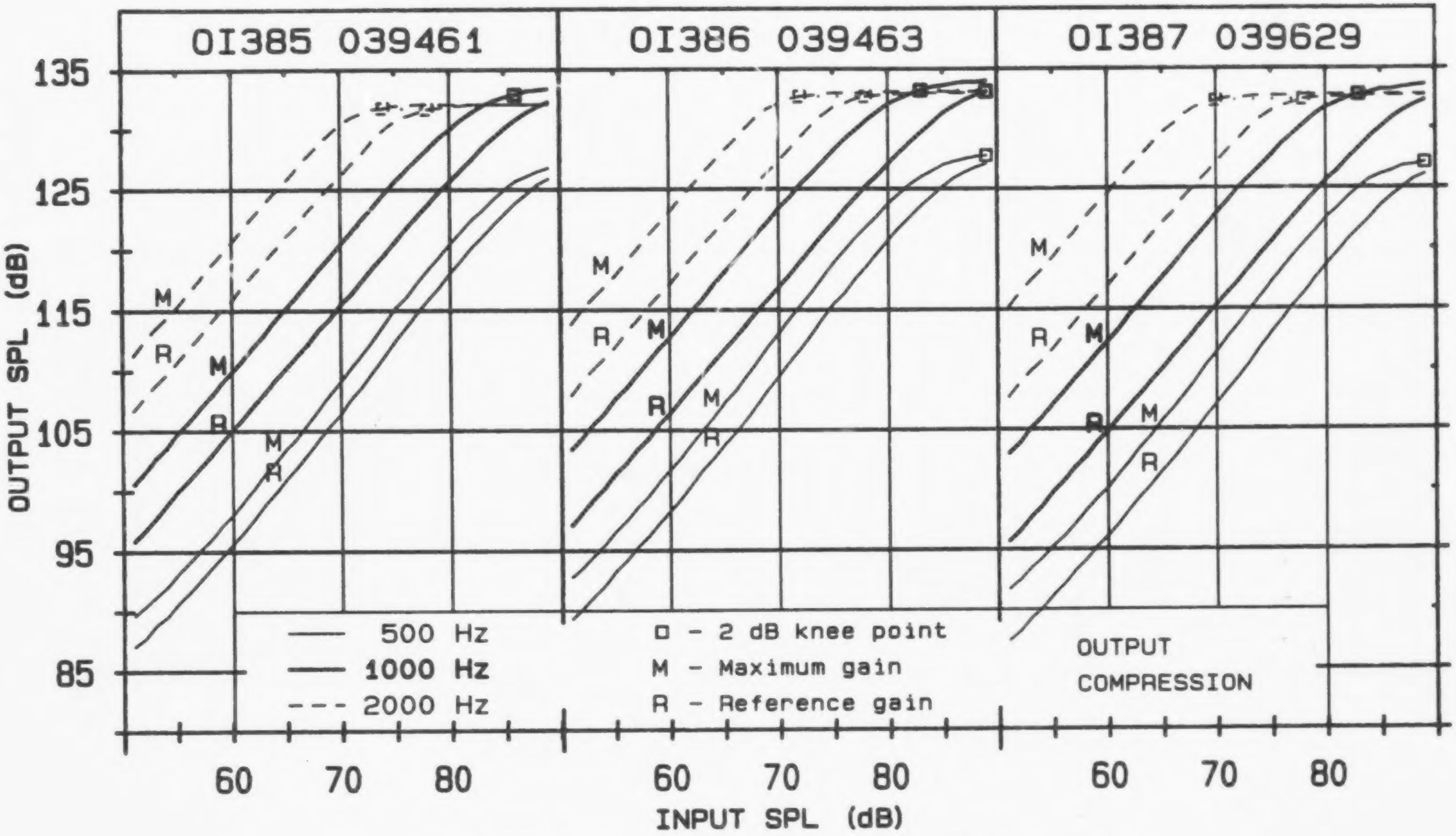
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
OI385	22.5	30	34.5	36.5	40	43	42	40	40	41.5
OI386	27	33	37	39	42.5	44.5	43.5	41.5	41.5	42.5
OI387	25	31	35	37	40	43	42	40.5	40.5	42

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
OI385	42.5	44	47	46	44	46	44.5	39.5	23.5	18.5
OI386	44	45.5	48	46.5	44.5	46.5	44	39	23.5	16
OI387	43.5	45	47.5	46.5	45	44.5	43	39	24	15.5

ts ts ts


OTICON - E25P
OI385N
OI386N
OI387N
INSERTION GAIN (dB)
50
40
30
20
10
0
THD
THD (%)
40
20
0
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

OTICON - E25P



OUTPUT SPL VS. INPUT SPL

ASP

OTICON - E30P

SETTINGS - A-GRAM:1.5 VC:4 P:132
BATTERY - 675

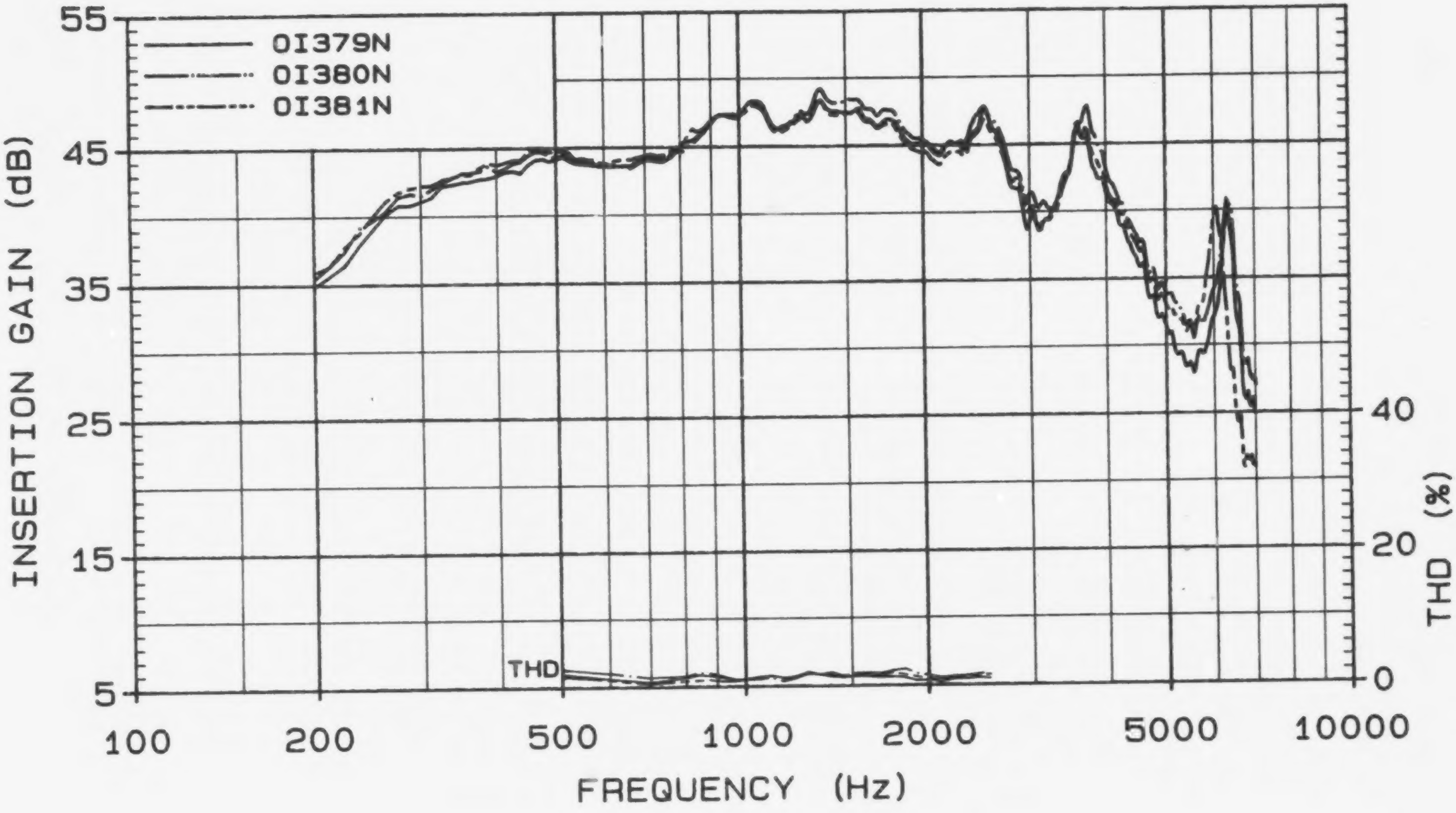
NBS CODE	OI379	OI380	OI381
SERIAL NO.	014241	014203	014208
DATE TESTED	6/24/88	6/28/88	6/28/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	60.5	60	61
SSPL for shaped noise signal (dB)	131	131.5	131.5
with input spl (dB)	70	70	70
Induction coil output level (dB)			
Self noise	90.5	93	92.5
Vertical field- 10 mA/m	116	110.5	109
Lateral field- 10 mA/m	93	93	93
Longitud field- 10 mA/m	106.5	100.5	105
Calculated maximum	116.5	111	110.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	47	47	47.5
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	2	3	2
800 Hz (%)	1	2	1
1600 Hz (%)	1	2	2
Maximum distortion above 800 Hz (%)	2	2	2
Freq. of max. (Hz)	1270	1830	1270
Equivalent input noise level (dB)	21	26.5	25.5
Battery drain (mA)			
No input signal	2.0	N.M.	2.0
With shaped input noise level=65dB	2.7	N.M.	2.9
Battery voltage (V)	1.31	N.M.	1.32

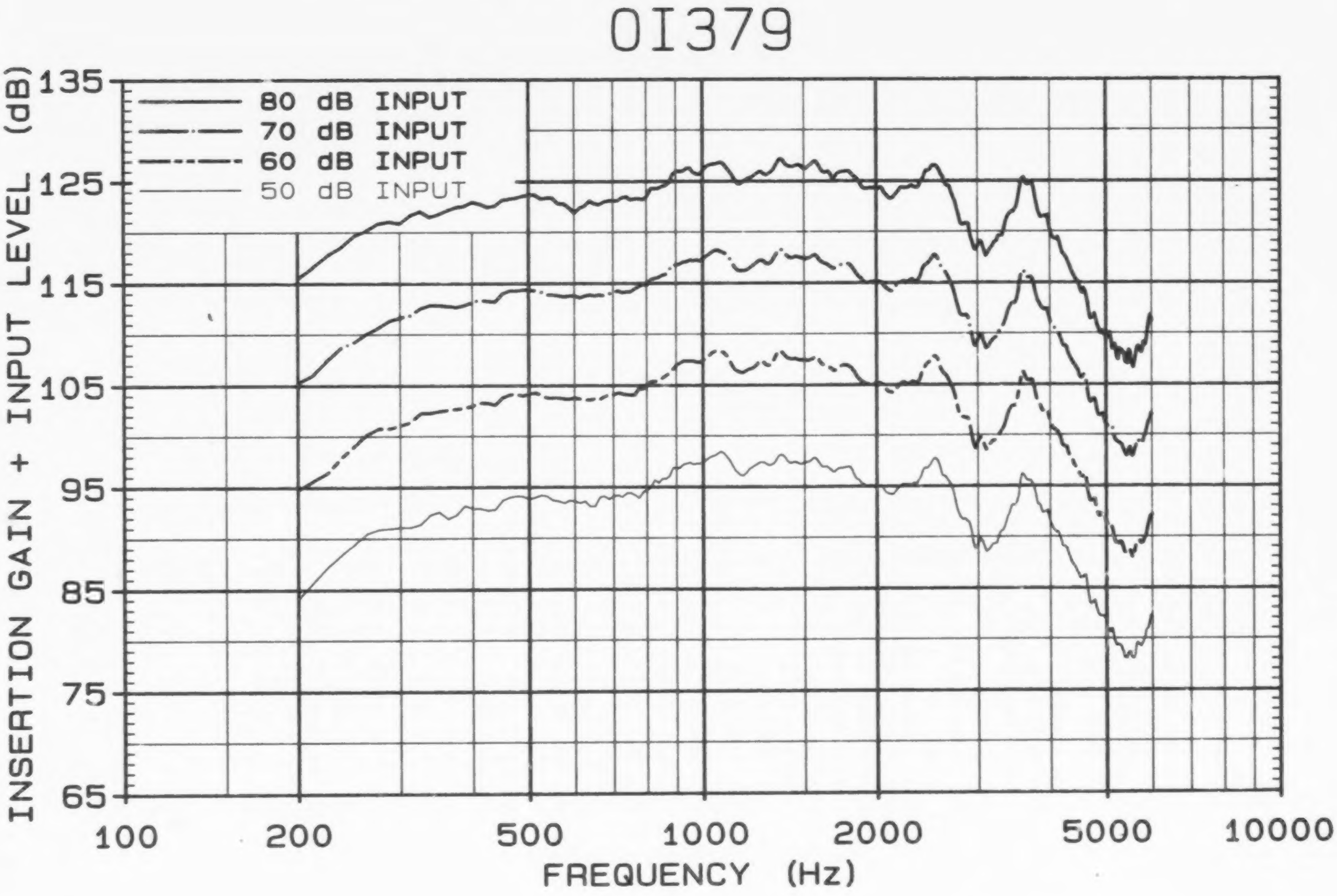
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
OI379	39	43	44	43.5	44.5	47	48	47	47.5	47.5
OI380	40	43.5	44.5	43.5	44.5	46.5	47.5	47	48.5	48
OI381	40	43.5	44.5	44	45	47	47.5	46.5	47.5	47

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
OI379	46.5	45.5	45	46	45.5	40	42.5	42	35	29.5
OI380	47.5	46	45	45.5	46	41.5	43	44	36.5	32.5
OI381	46.5	45	44	45	45	40.5	42.5	43	36	33
							edb	edb	edb	

OTICON - E30P


OI379N
OI380N
OI381N
INSERTION GAIN (dB)
55
45
35
25
15
5
THD
THD (%)
40
20
0
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)


OI379
80 dB INPUT
70 dB INPUT
60 dB INPUT
50 dB INPUT
INSERTION GAIN + INPUT LEVEL (dB)
135
125
115
105
95
85
75
65
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

OTICON - E39PL CO

SETTINGS - A-GRAM:3 UCL:136 AGC:130 VC:4
BATTERY - 675

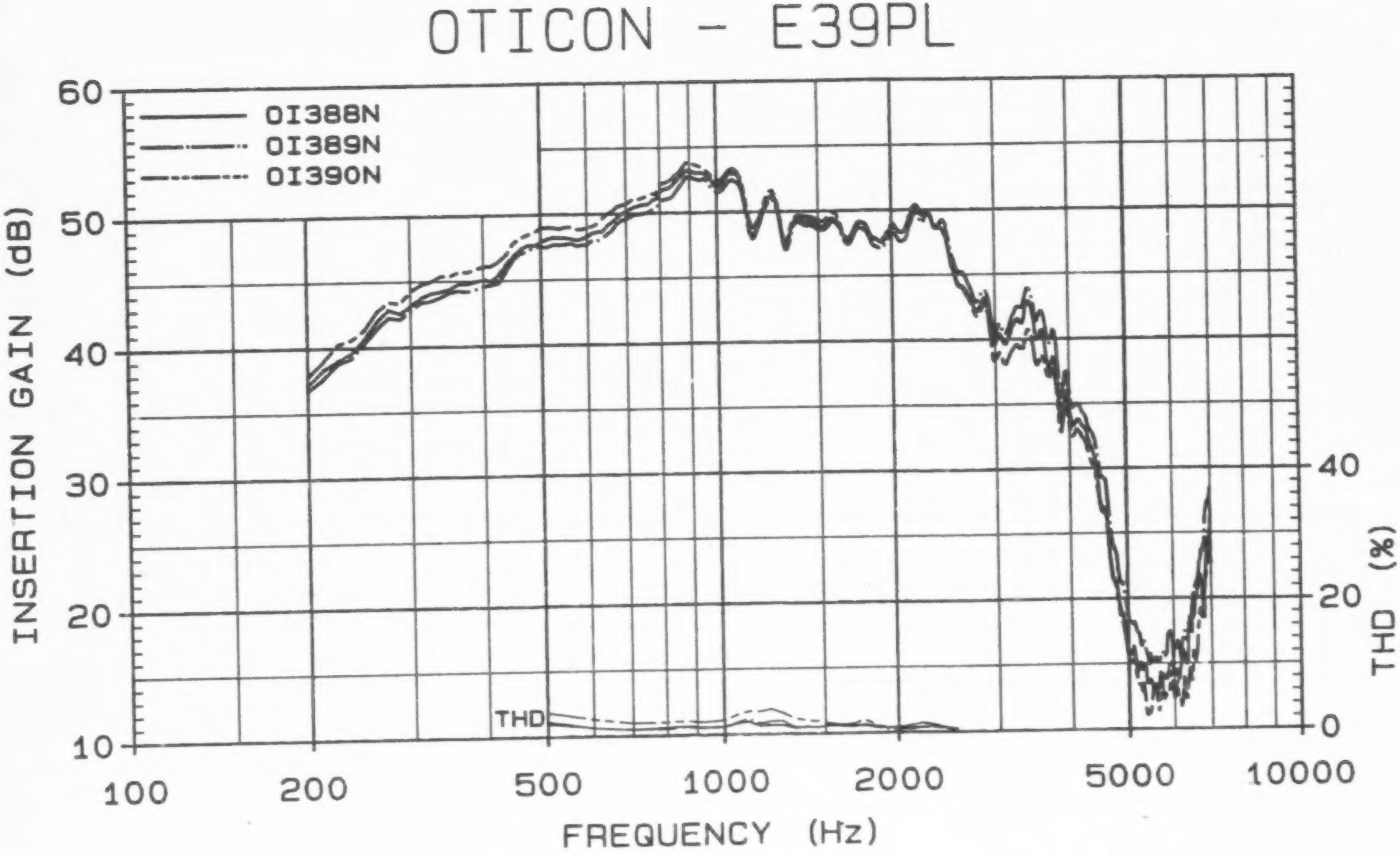
NBS CODE	OI388	OI389	OI390
SERIAL NO.	010272	010250	000275
DATE TESTED	5/17/88	5/17/88	5/17/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	61.5	59	58.5
SSPL for shaped noise signal (dB)	133.5	133.5	133.5
with input spl (dB)	76	80	78
Induction coil output level (dB)			
Self noise	84	84	84
Vertical field- 10 mA/m	110	110.5	111
Lateral field- 10 mA/m	96.5	99.5	101.5
Longitud field- 10 mA/m	97.5	95	92
Calculated maximum	110.5	110.5	111.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	51.5	50.5	51.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	2	2	4
800 Hz (%)	1	1	2
1600 Hz (%)	1	1	1
Maximum distortion above 800 Hz (%)	2	2	4
Freq. of max. (Hz)	1100	1100	1210
Equivalent input noise level (dB)	22	23	23
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.33	1.33	1.33

Average insertion gain (dB) in 20 bands (center frequencies shown)

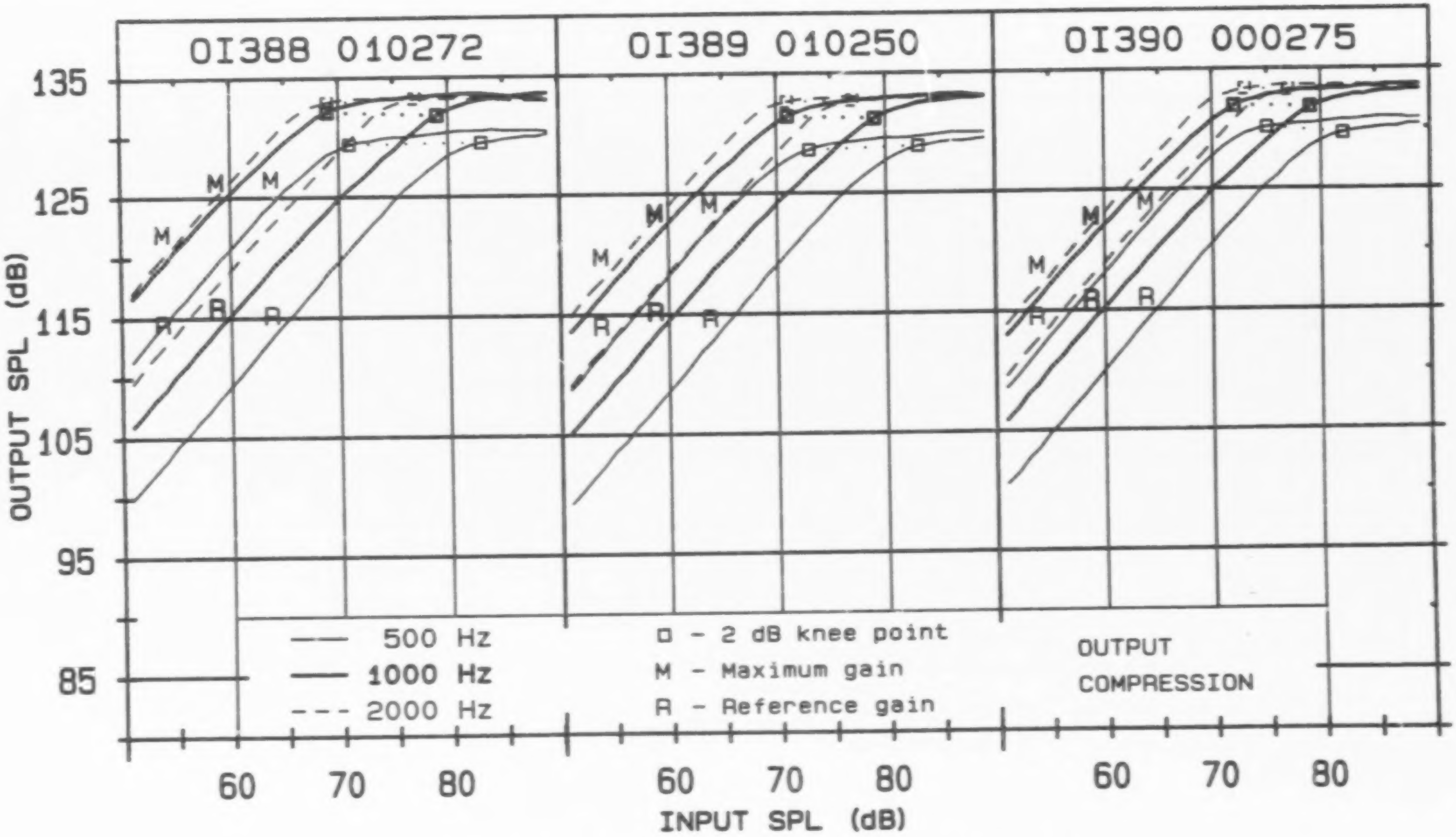
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
OI388	41	45	47.5	49	51	53	52	50	49	49
OI389	41	44.5	47	48	50.5	52.5	51.5	49.5	48.5	48.5
OI390	42	46	48.5	49.5	51.5	53.5	52.5	50	49	49.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
OI388	48.5	48	49	49	44	41	41.5	35.5	24.5	14.5
OI389	48	47.5	48.5	49	45	41.5	42.5	37	26.5	16.5
OI390	48.5	48	49	49	44	40	39.5	34.5	24	13

ts ts ts


OTICON - E39PL

OTICON - E39PL



OUTPUT SPL VS. INPUT SPL

OTICON - E40 HP

SETTINGS - A-GRAM:4 dBHL:75 VC:4
BATTERY - 13

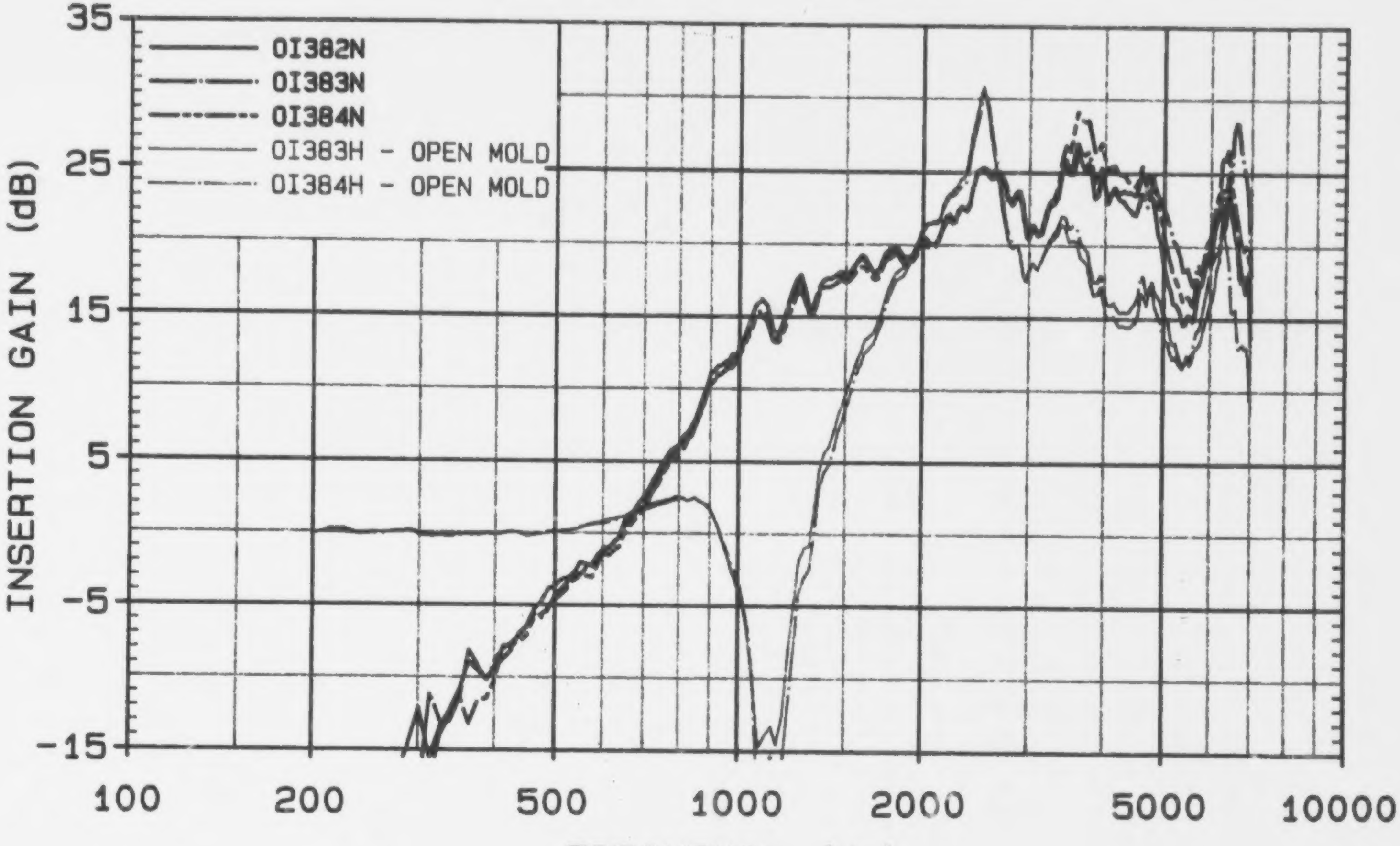
NBS CODE	OI382	OI383	OI384
SERIAL NO.	010815	364763	010837
DATE TESTED	5/5/88	5/6/88	5/6/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	25	25.5	25.5
SSPL for shaped noise signal (dB)	110	110.5	110.5
with input spl (dB)	80	78	80
Induction coil output level (dB)			
Self noise	62	62	62
Vertical field- 10 mA/m	90	88.5	89.5
Lateral field- 10 mA/m	67.5	72	65
Longitud field- 10 mA/m	76	79	79.5
Calculated maximum	90	89	90
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	12.5	12	12
Equivalent input noise level (dB)	26.5	27	28
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.35	1.35	1.33

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
OI382	-18	-9.5	-4	-0.5	5.5	11	15	16	17	18.5
OI383	-17.5	-9.5	-5	-0.5	5	10.5	14.5	16	17.5	18.5
OI384	-17.5	-10.5	-5	-1	4.5	10.5	14	15	17	18

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
OI382	19	19.5	21	23	24.5	22	24.5	24	23	16.5
OI383	19	19.5	21	23.5	24.5	21.5	24.5	24.5	23	19
OI384	18.5	19	20.5	23	24	21.5	26	26.5	24	18
								ts	ts	ts

OTICON - E40


35
25
15
5
-5
-15
INSERTION GAIN (dB)
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)
OI382N
OI383N
OI384N
OI383H - OPEN MOLD
OI384H - OPEN MOLD

PHILIPS - P47-IH

HP

SETTINGS - N/H:H P:105
BATTERY - 13

NBS CODE	PH364	PH365	PH366
SERIAL NO.	804091	804109	804088
DATE TESTED	5/4/88	5/5/88	5/5/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	33	31	34.5
SSPL for shaped noise signal (dB)	111.5	112	112
with input spl (dB)	58	60	58
Induction coil output level (dB)			
Self noise	65	64.5	66
Vertical field- 10 mA/m	93	94.5	96
Lateral field- 10 mA/m	71	72.5	79.5
Longitud field- 10 mA/m	83	81.5	89
Calculated maximum	93.5	94.5	97
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	16.5	15.5	16.5
Equivalent input noise level (dB)	26.5	26	25
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.35	1.35	1.35

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
PH364	-18	-9.5	-0.5	6	11.5	16	19	21	23.5	26
PH365	-18.5	-13	-2.5	4	10	15	18.5	20.5	22.5	25.5
PH366	-17	-11	-1	5	11	16	19.5	21.5	23.5	26

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
PH364	27.5	28	28	25	22	22.5	25.5	25	23.5	25
PH365	26.5	27.5	27.5	24.5	21.5	22	25.5	25	26	29.5
PH366	27	27.5	27.5	26	23	23	26	26	23.5	25
								ts	ts	ts

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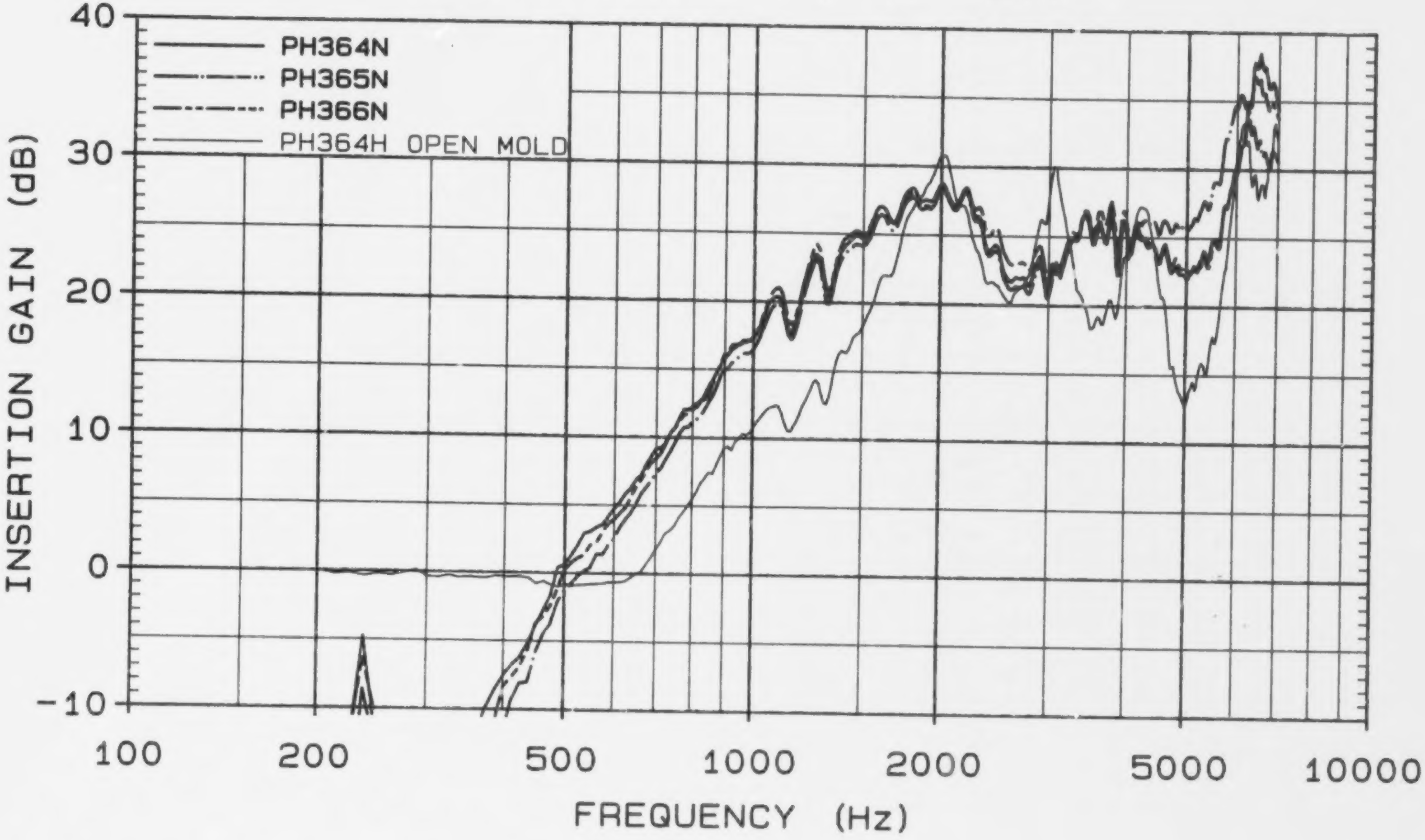


PHILIPS - P47-IH

PHILIPS - P47-I CO

SETTINGS - N: P:105
BATTERY - 13

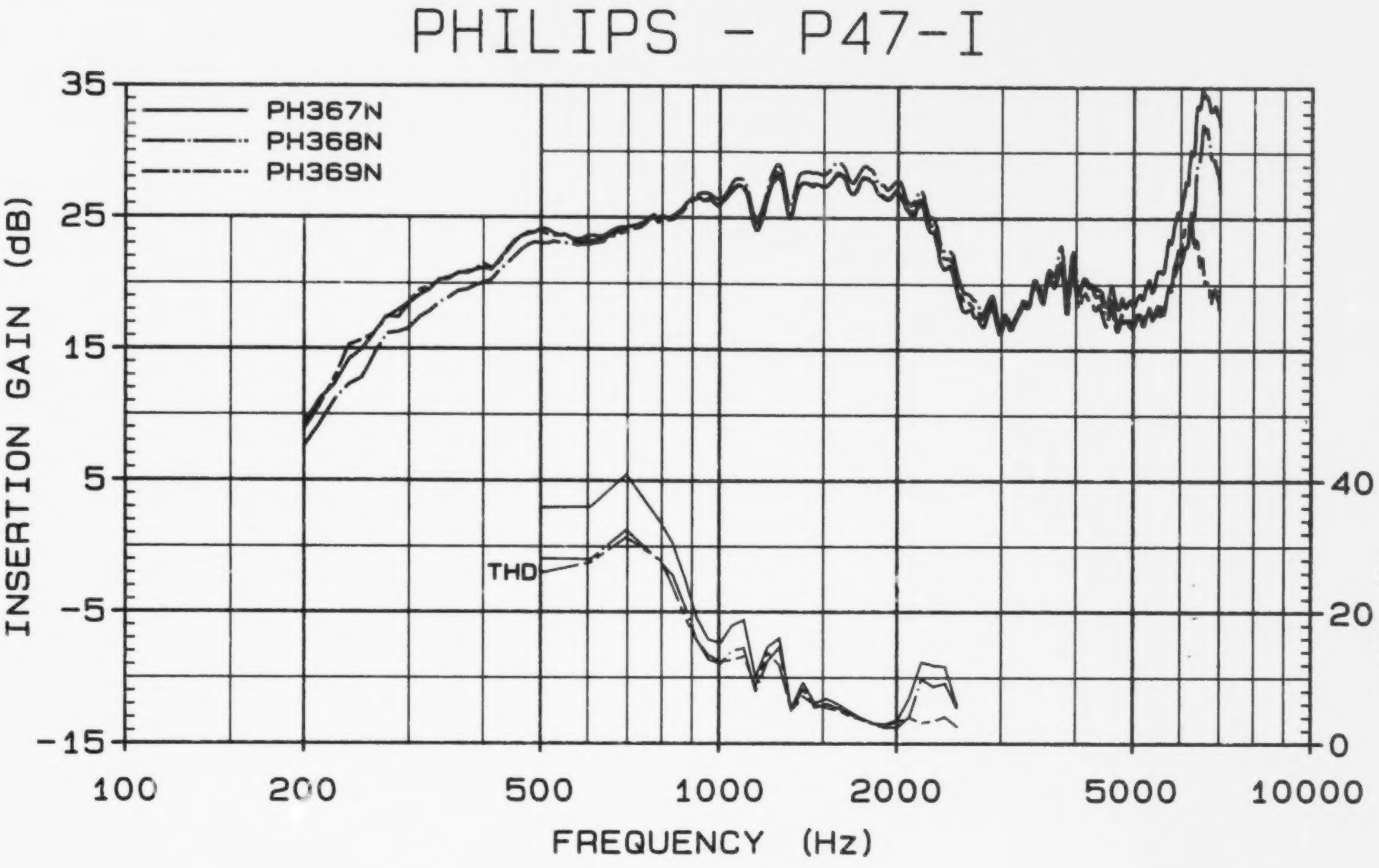
NBS CODE	PH367	PH368	PH369
SERIAL NO.	648036	803222	803232
DATE TESTED	5/9/88	5/9/88	5/9/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	43	43	43.5
SSPL for shaped noise signal (dB)	109	109.5	109.5
with input spl (dB)	54	54	54
Induction coil output level (dB)			
Self noise	73	72	72.5
Vertical field= 10 mA/m	107	106.5	107
Lateral field= 10 mA/m	80	88	83
Longitud field= 10 mA/m	101.5	100.5	100.5
Calculated maximum	108	107.5	108
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	25	25.5	25
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	36	28	26
800 Hz (%)	34	27	28
1600 Hz (%)	6	5	5
Maximum distortion above 800 Hz (%)	30	26	24
Freq. of max. (Hz)	830	830	830
Equivalent input noise level (dB)	27	27.5	27
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.33	1.34	1.33

Average insertion gain (dB) in 20 bands (center frequencies shown)

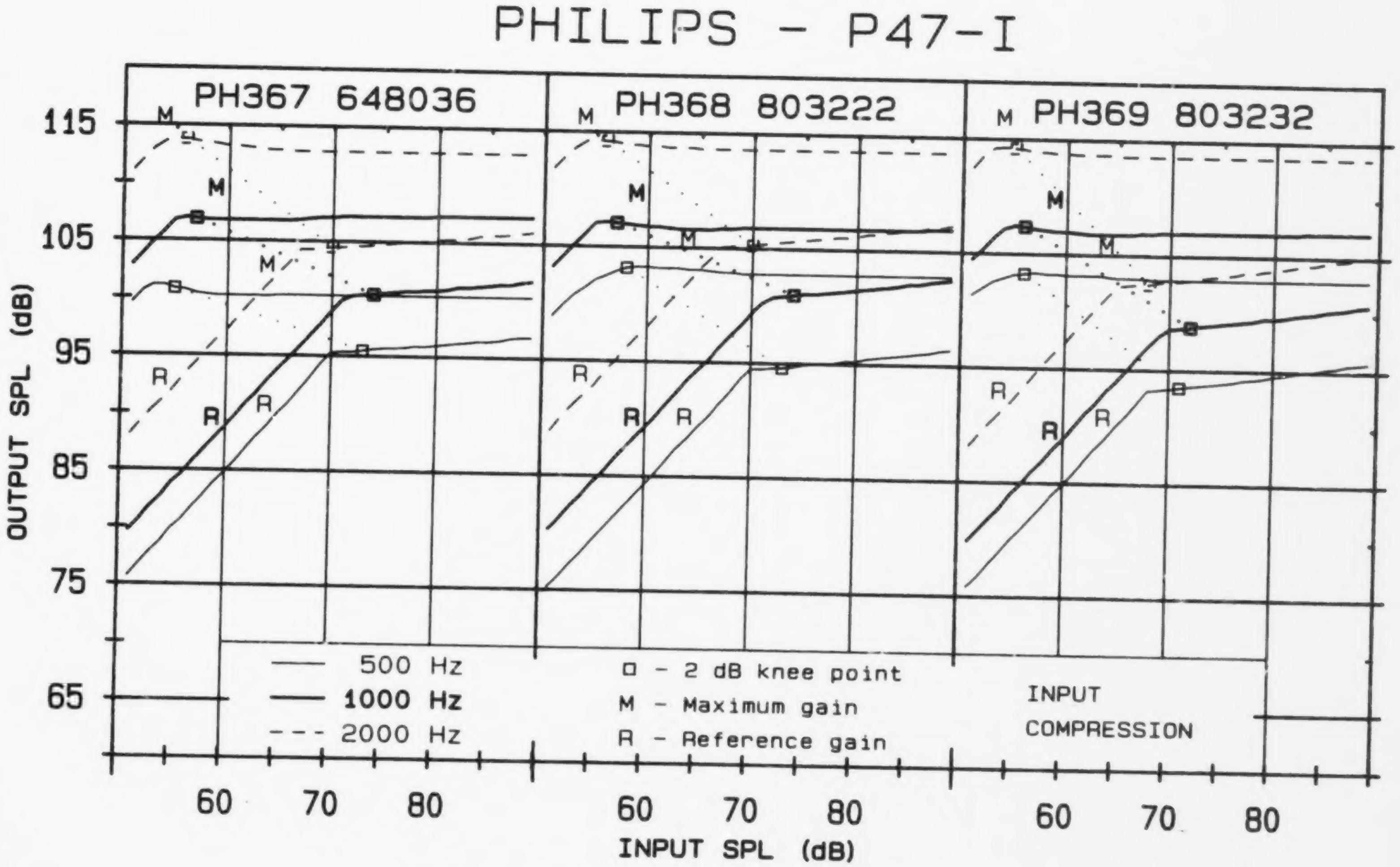
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
PH367	15.5	21	23.5	23.5	25	26	26.5	26.5	27	28
PH368	14	19.5	22.5	23.5	25	26.5	27	27	28	28.5
PH369	15.5	21	23.5	23.5	24.5	26	26.5	26.5	27	28

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
PH367	27.5	26.5	25.5	22.5	18	17	19	20	19	21.5
PH368	28.5	27.5	26.5	23.5	19	18	19.5	20.5	18	18.5
PH369	27.5	27	26	23	18.5	17.5	19.5	19.5	17.5	19

ts ts ts



PHILIPS - P47-I



OUTPUT SPL VS. INPUT SPL

PHONIC_EAR - PE 600 CHD **HP**

SETTINGS - SSPL:128 TONE:H1
BATTERY - 675

NBS CODE	PN109	PN110	PN111
SERIAL NO.	H109425	H109401	H109442
DATE TESTED	5/2/88	5/2/88	5/3/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	43	45	44
SSPL for shaped noise signal (dB)	128.5	128.5	128.5
with input spl (dB)	76	76	74
Induction coil output level (dB)			
Self noise	69.5	70	71
Vertical field= 10 mA/m	99.5	99.5	100
Lateral field= 10 mA/m	80.5	76	86
Longitud field= 10 mA/m	88	88	87
Calculated maximum	100	99.5	100.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	38.5	39	37.5
Equivalent input noise level (dB)	16.5	16	16.5
Battery drain (mA)			
No input signal	0.4	0.4	0.5
With shaped input noise level=65dB	0.6	0.5	0.5
Battery voltage (V)	1.33	1.33	1.33

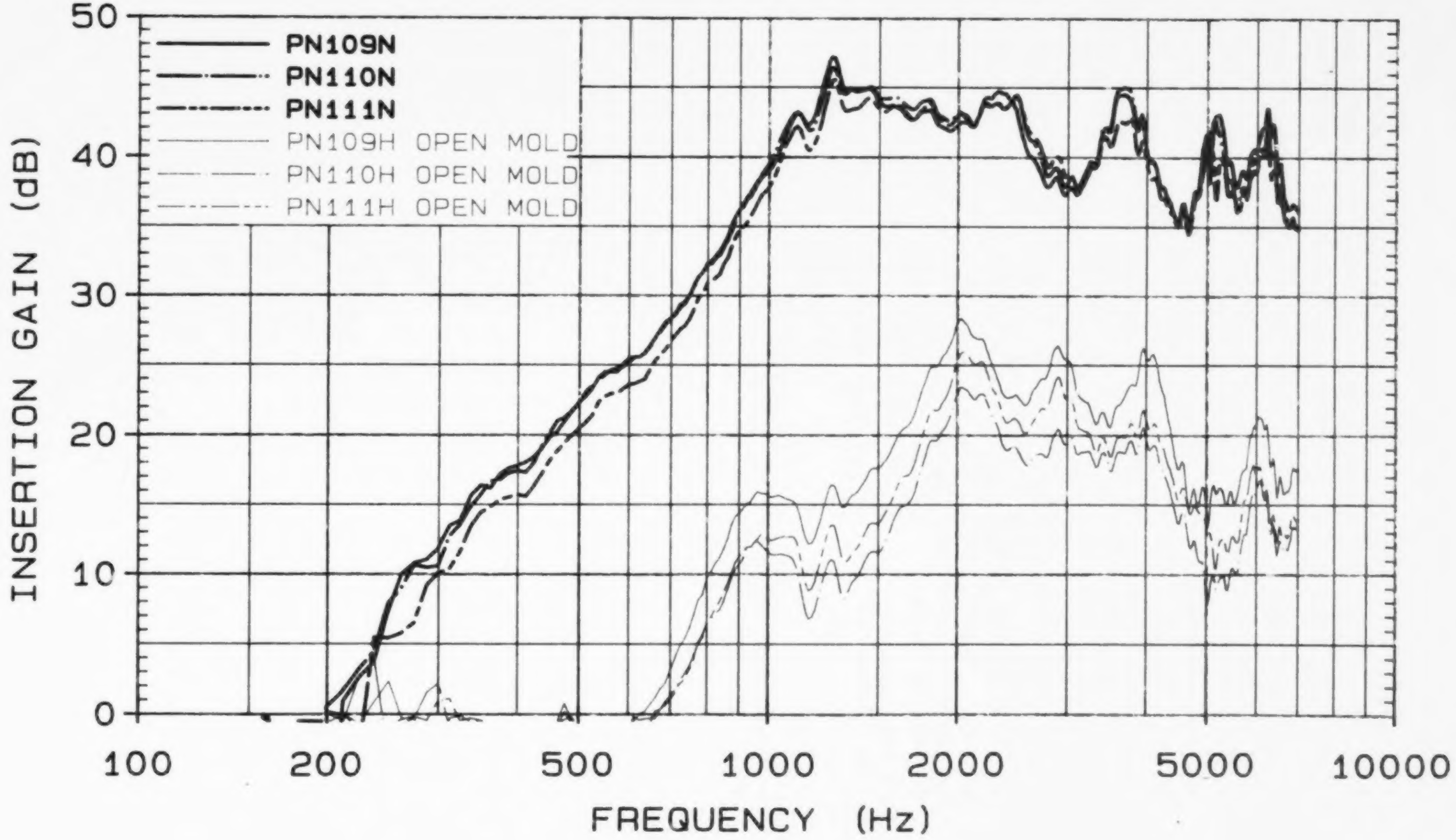
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
PN109	6.5	17	22	26	31	36.5	41.5	45	45	43.5
PN110	7.5	17	22	26	31	36.5	42	44.5	45	44
PN111	5.5	15	20	24	29.5	35	40.5	43	43.5	43.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
PN109	43	42	43	44.5	39.5	38	41.5	41.5	37.5	40
PN110	44	43	43	44	41	38.5	41.5	42	37	39
PN111	43.5	42.5	43	44	41.5	39	40.5	40.5	37	38.5

ts ts ts

PHONIC_EAR - PE 600 CHD



PHONIC_EAR - PE 805 CD2 CO

SETTINGS - SSPL:5 TONE:1
BATTERY - 675

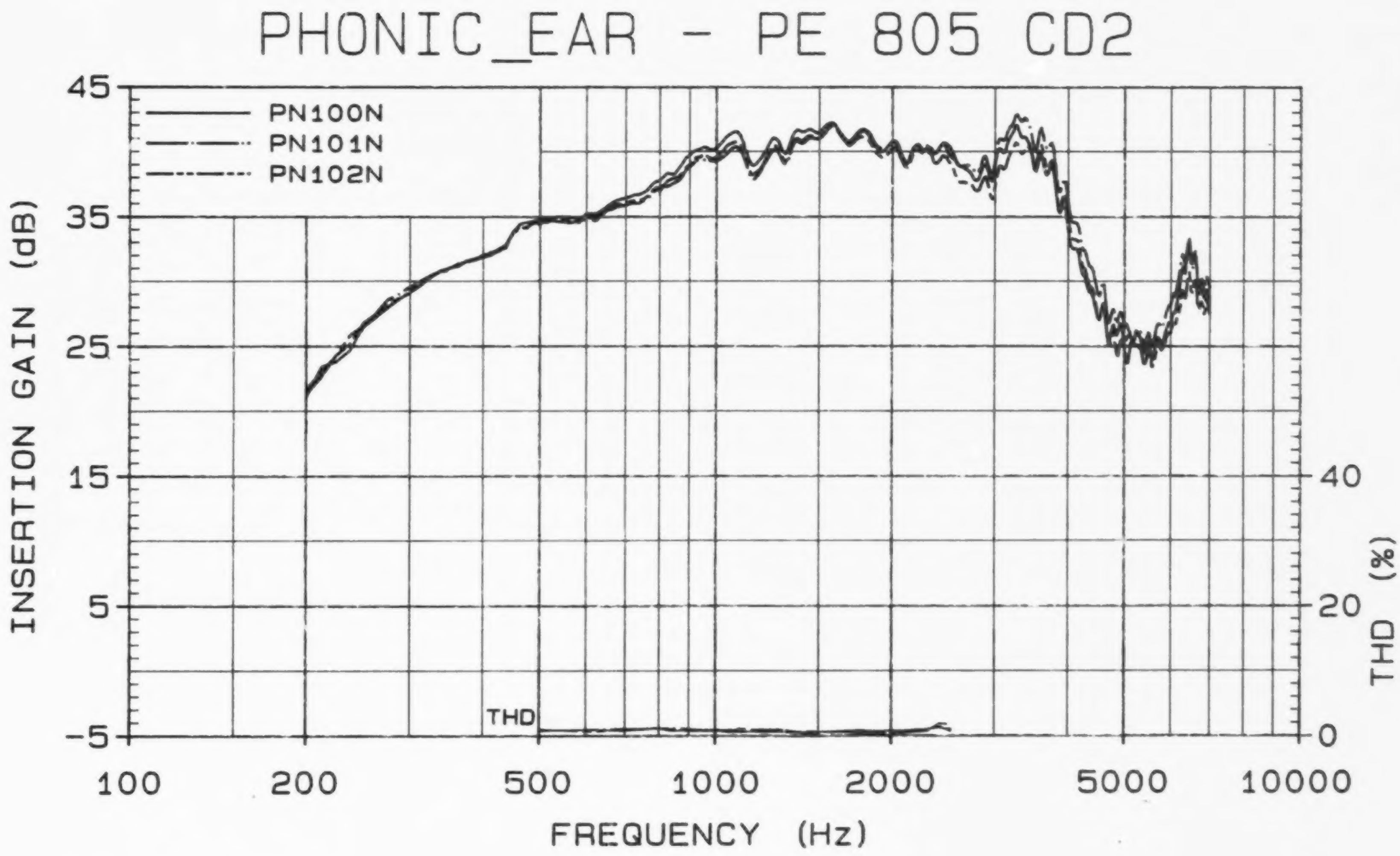
NBS CODE	PN100	PN101	PN102
SERIAL NO.	G271458	G271475	G271493
DATE TESTED	6/14/88	6/14/88	6/14/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	40	43.5	42.5
SSPL for shaped noise signal (dB)	125	125.5	125
with input spl (dB)	80	76	78
Induction coil output level (dB)			
Self noise	69.5	70	68
Vertical field- 10 mA/m	102.5	108	102
Lateral field- 10 mA/m	75	81.5	82.5
Longitud field- 10 mA/m	89	88.5	87.5
Calculated maximum	102.5	108	102.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	39	38	38.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	1	1	1
800 Hz (%)	1	1	1
1600 Hz (%)	1	0	1
Maximum distortion above 800 Hz (%)	1	2	1
Freq. of max. (Hz)	2410	2410	2410
Equivalent input noise level (dB)	22	21	21
Battery drain (mA)			
No input signal	2.0	2.1	1.9
With shaped input noise level-65dB	2.0	2.1	1.9
Battery voltage (V)	1.30	1.30	1.31

Average insertion gain (dB) in 20 bands (center frequencies shown)

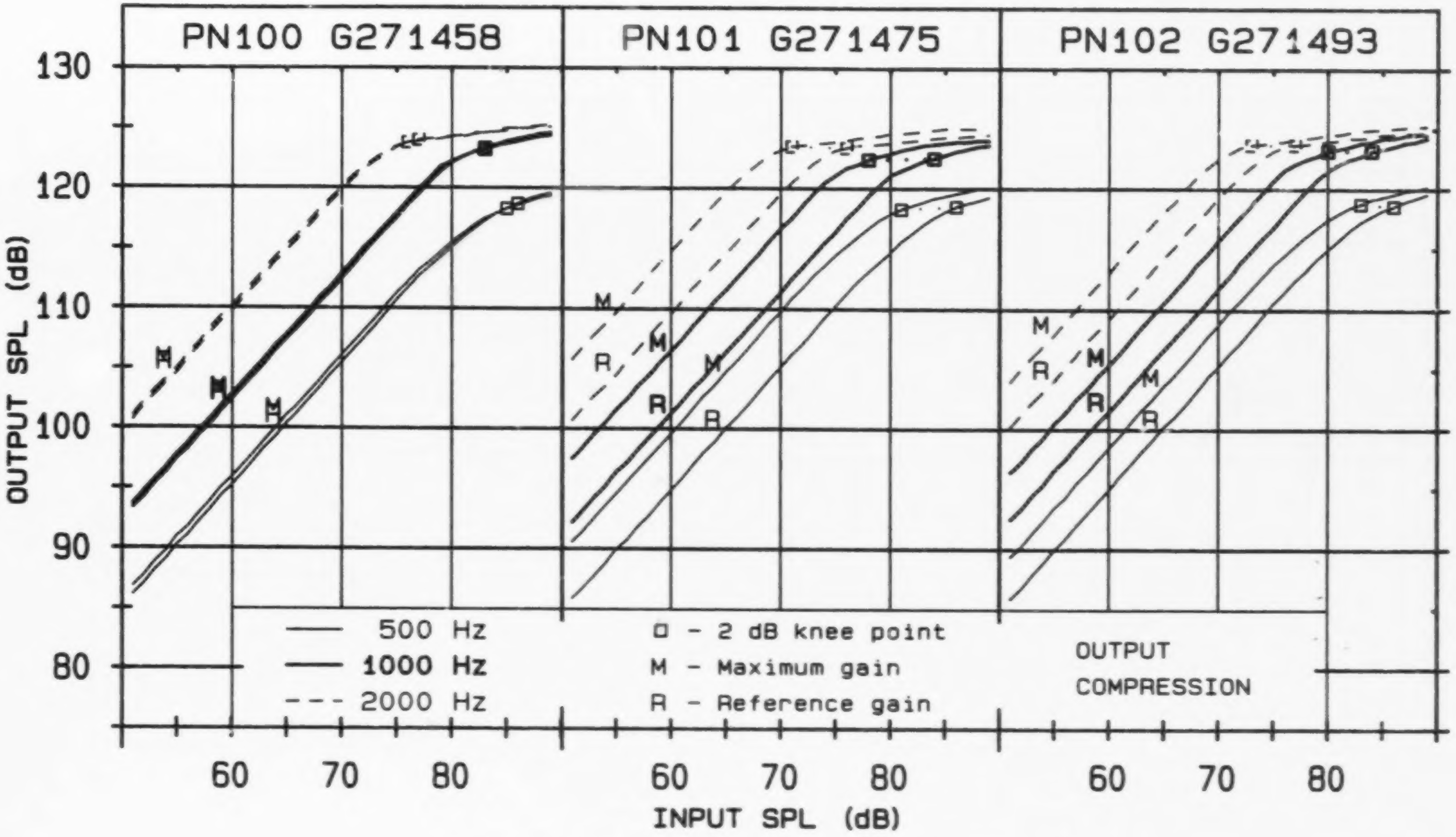
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
PN100	26.5	31.5	34.5	35.5	37.5	40	41	40	41.5	42
PN101	27	31.5	34.5	35	36.5	39	39.5	39	40.5	41.5
PN102	27	31.5	34.5	35	37	39	40	39.5	40.5	41.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
PN100	41	40.5	40	40	38.5	39.5	40.5	35	27.5	25.5
PN101	41.5	40.5	40	40.5	39	40	42	37	29	26
PN102	41	40	39.5	39.5	38	38	40	35.5	27	25

edb edb edb


PHONIC_EAR - PE 805 CD2
PN100N
PN101N
PN102N
INSERTION GAIN (dB)
45
35
25
15
5
-5
THD
THD (%)
40
20
0
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

PHONIC_EAR - PE 805 CD2



OUTPUT SPL VS. INPUT SPL

PHONIC_EAR - PE 805 SCD2 CO

SETTINGS - SSPL:5 TONE:1
BATTERY - 675

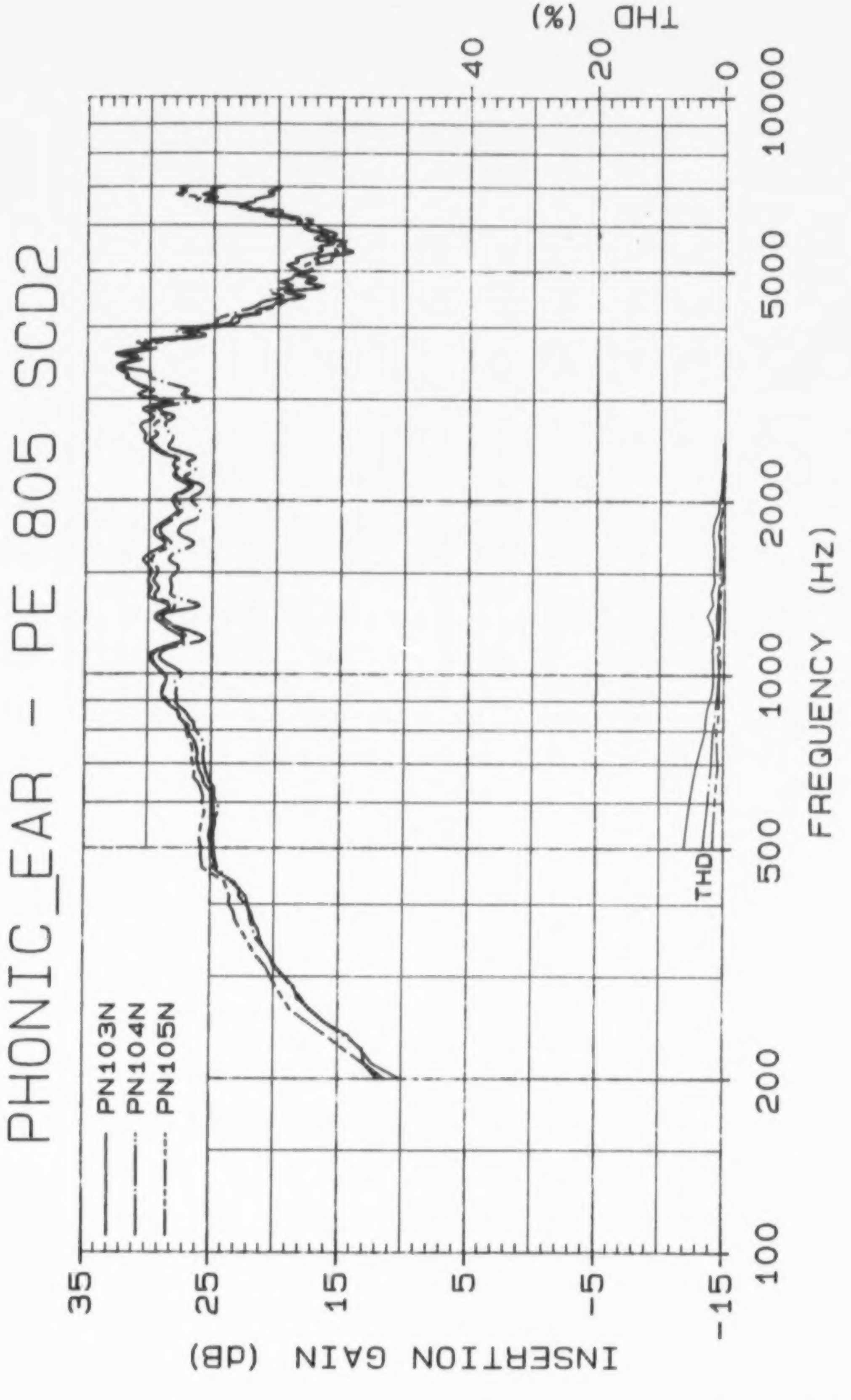
NBS CODE	PN103	PN104	PN105
SERIAL NO.	H102607	H102623	H102645
DATE TESTED	6/9/88	5/17/88	6/9/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	48	47	48
SSPL for shaped noise signal (dB)	116	115.5	115.5
with input spl (dB)	82	82	82
Induction coil output level (dB)			
Self noise	73	71	73
Vertical field- 10 mA/m	107	104.5	111.5
Lateral field- 10 mA/m	94.5	87	95.5
Longitud field- 10 mA/m	92.5	90.5	98
Calculated maximum	107	104.5	112
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	27.5	26.5	27.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	6	3	2
800 Hz (%)	3	2	1
1600 Hz (%)	2	1	0
Maximum distortion above 800 Hz (%)	3	1	1
Freq. of max. (Hz)	830	830	1150
Equivalent input noise level (dB)	21.5	22	21
Battery drain (mA)			
No input signal	2.0	N.M.	2.0
With shaped input noise level-65dB	2.0	N.M.	2.0
Battery voltage (V)	1.30	1.33	1.30

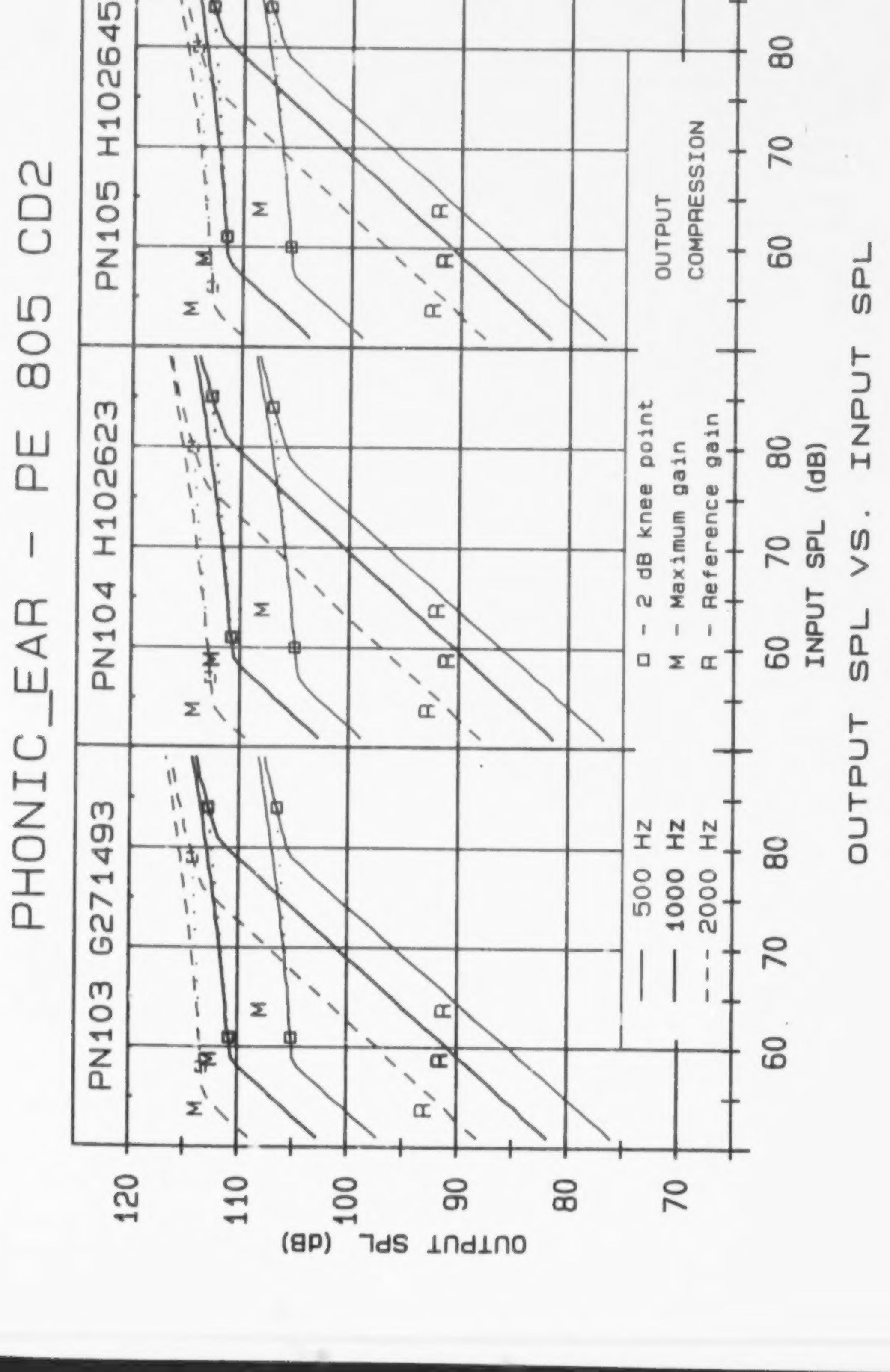
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
PN103	16.5	22	24.5	25.5	26.5	28.5	29	28.5	29.5	30
PN104	16.5	22	24.5	25	26	27.5	28	27.5	28	28
PN105	17.5	23	25.5	26	27	28.5	29	28	29	29.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
PN103	29	28	27.5	28.5	30.5	30.5	32	26.5	19	17.5
PN104	27	26.5	26.5	27	28.5	28	31	27	20	16
PN105	29	28	27.5	28.5	29.5	29.5	31.5	25.5	18.5	16.5

edb ts edb


PHONIC_EAR - PE 805 SCD2
PN103N
PN104N
PN105N
INSERTION GAIN (dB)
35
25
15
5
-5
-15
THD (%)
40
20
0
THD
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)


PHONIC_EAR - PE 805 CD2
PN103 G271493
PN104 H102623
PN105 H102645
500 Hz
1000 Hz
2000 Hz
□ - 2 dB knee point
M - Maximum gain
R - Reference gain
OUTPUT COMPRESSION
M
R
120
110
100
90
80
70
OUTPUT SPL (dB)
60
70
80
INPUT SPL (dB)
OUTPUT SPL VS. INPUT SPL

PHONIC_EAR - PE 845 PPC CO

SETTINGS - SSPL:138 TONE:L
BATTERY - 675

NBS CODE	PN097	PN098	PN099
SERIAL NO.	G269307	G269322	G269347
DATE TESTED	6/14/88	6/15/88	6/15/88

DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING

	PN097	PN098	PN099
Gain at 1kHz (dB)	72	72.5	71.5
SSPL for shaped noise signal (dB)	134.5	134	133.5
with input spl (dB)	66	64	66
Induction coil output level (dB)			
Self noise	89	89	88.5
Vertical field= 10 mA/m	120	120	119
Lateral field= 10 mA/m	109	109.5	105
Longitud field= 10 mA/m	102	102	88.5
Calculated maximum	120.5	120.5	119

DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING

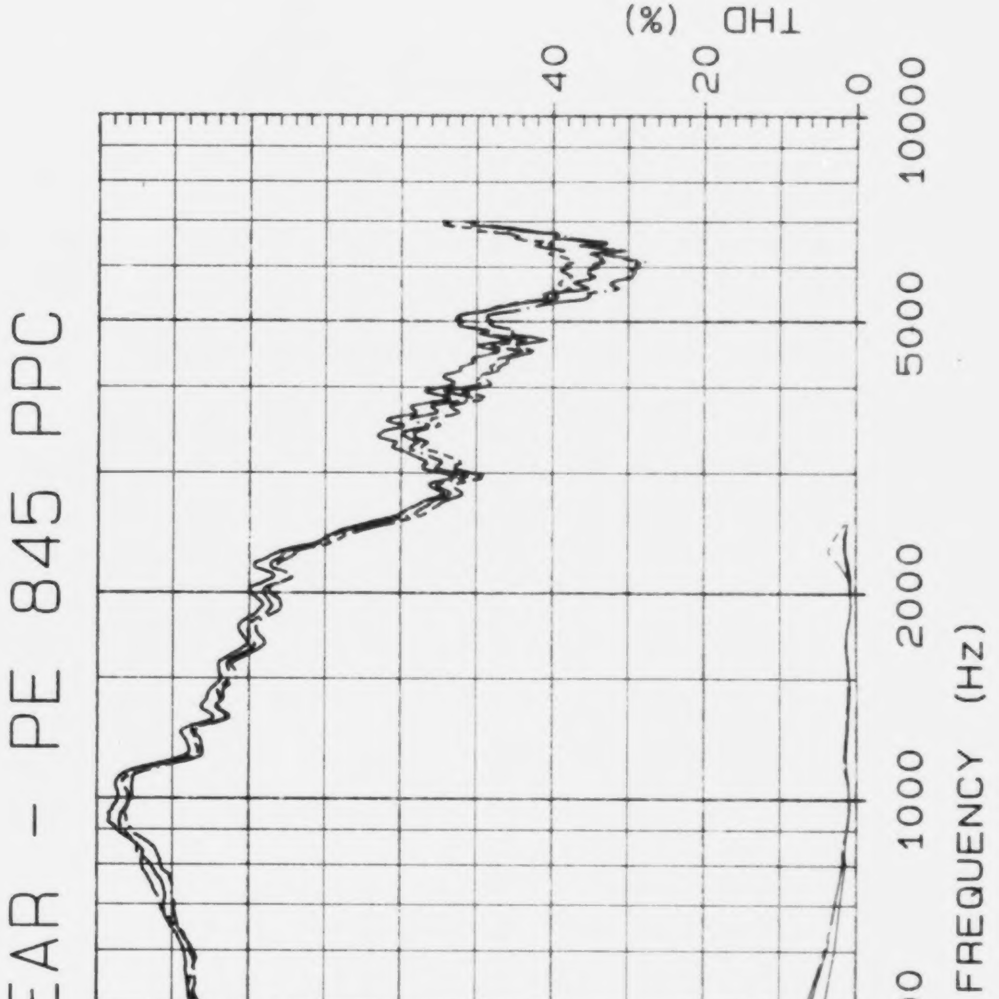
	PN097	PN098	PN099
Gain at 1kHz (dB)	57.5	56.5	57
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	4	6	6
800 Hz (%)	1	2	2
1600 Hz (%)	1	1	1
Maximum distortion above 800 Hz (%)	2	2	4
Freq. of max. (Hz)	2410	830	2300
Equivalent input noise level (dB)	20.5	20.5	21.5
Battery drain (mA)			
No input signal	0.9	1.0	1.0
With shaped input noise level=65dB	2.6	2.3	2.3
Battery voltage (V)	1.32	1.32	1.31

Average insertion gain (dB) in 20 bands (center frequencies shown)

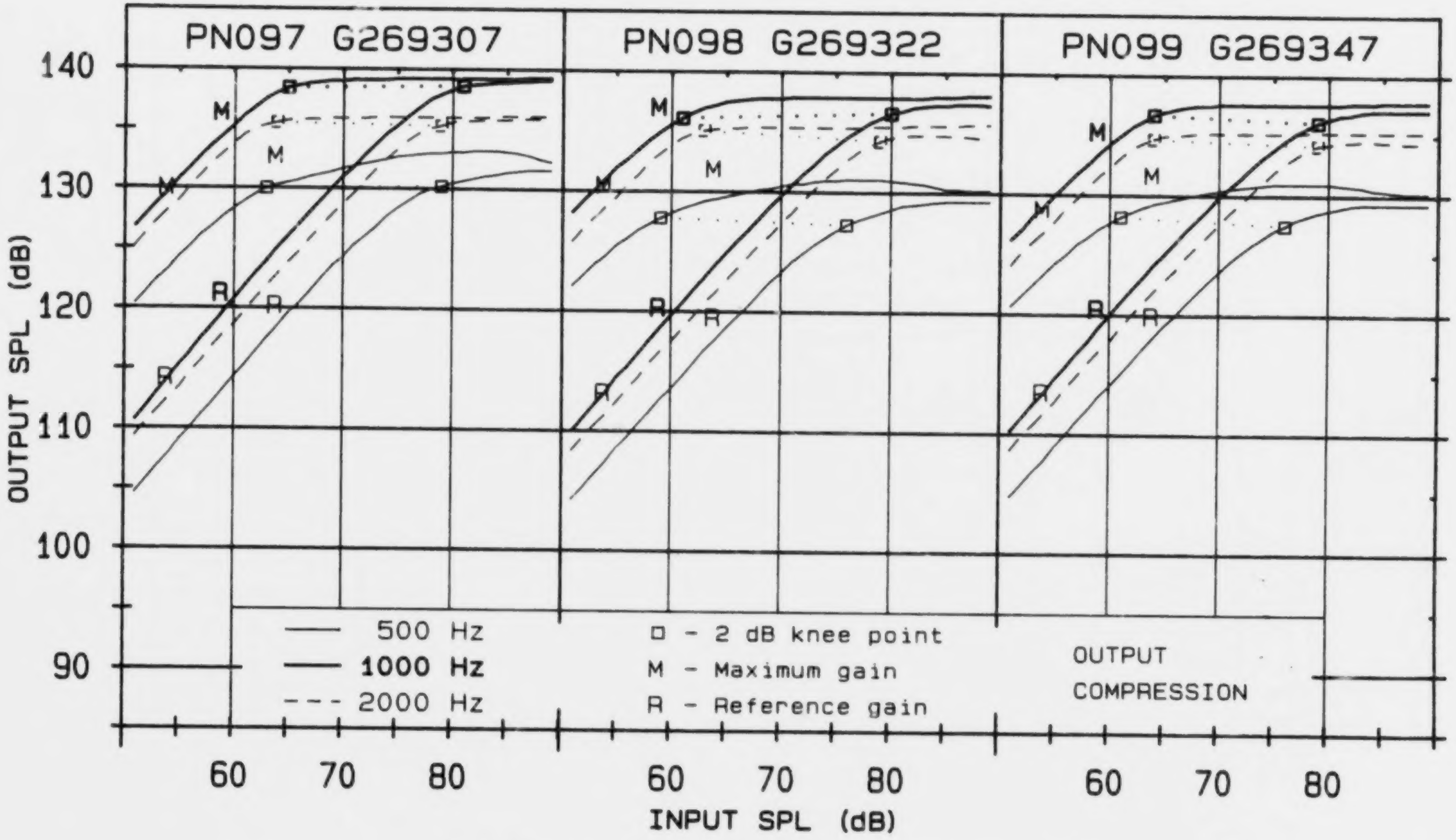
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
PN097	43	49.5	53.5	54.5	56	58.5	58	54	52.5	51.5
PN098	43.5	49	53	54	55.5	57.5	57	53	51.5	50.5
PN099	43	49	53	54.5	56.5	58	57.5	53.5	52	51

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
PN097	50.5	49.5	49	46	39.5	38	40.5	37.5	35	30.5
PN098	49.5	48.5	48	45.5	39	37	39	36	32.5	28
PN099	50	49	48	45	38	36	38	35	34	31

edb edb edb


PHONIC_EAR - PE 845 PPC
PN097N
PN098N
PN099N
INSERTION GAIN (dB)
60
50
40
30
20
10
FREQUENCY (Hz)
100
200
500
1000
2000
5000
10000
THD (%)
40
20
0
THD

PHONIC_EAR - PE 845 PPC



OUTPUT SPL VS. INPUT SPL

PHONIC_EAR - PE 860 PPC CO

SETTINGS - SSPL:6 TONE:0
BATTERY - 13

NBS CODE	PN106	PN107	PN108
SERIAL NO.	H134402	H134435	H134449
DATE TESTED	6/14/88	6/14/88	6/14/88

DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING

	PN106	PN107	PN108
Gain at 1kHz (dB)	63	61.5	61
SSPL for shaped noise signal (dB)	132	132	132
with input spl (dB)	68	70	70
Induction coil output level (dB)			
Self noise	80.5	80.5	80.5
Vertical field- 10 mA/m	119	112.5	112.5
Lateral field- 10 mA/m	91.5	87.5	84
Longitud field- 10 mA/m	98.5	94	97.5
Calculated maximum	119	113	112.5

DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING

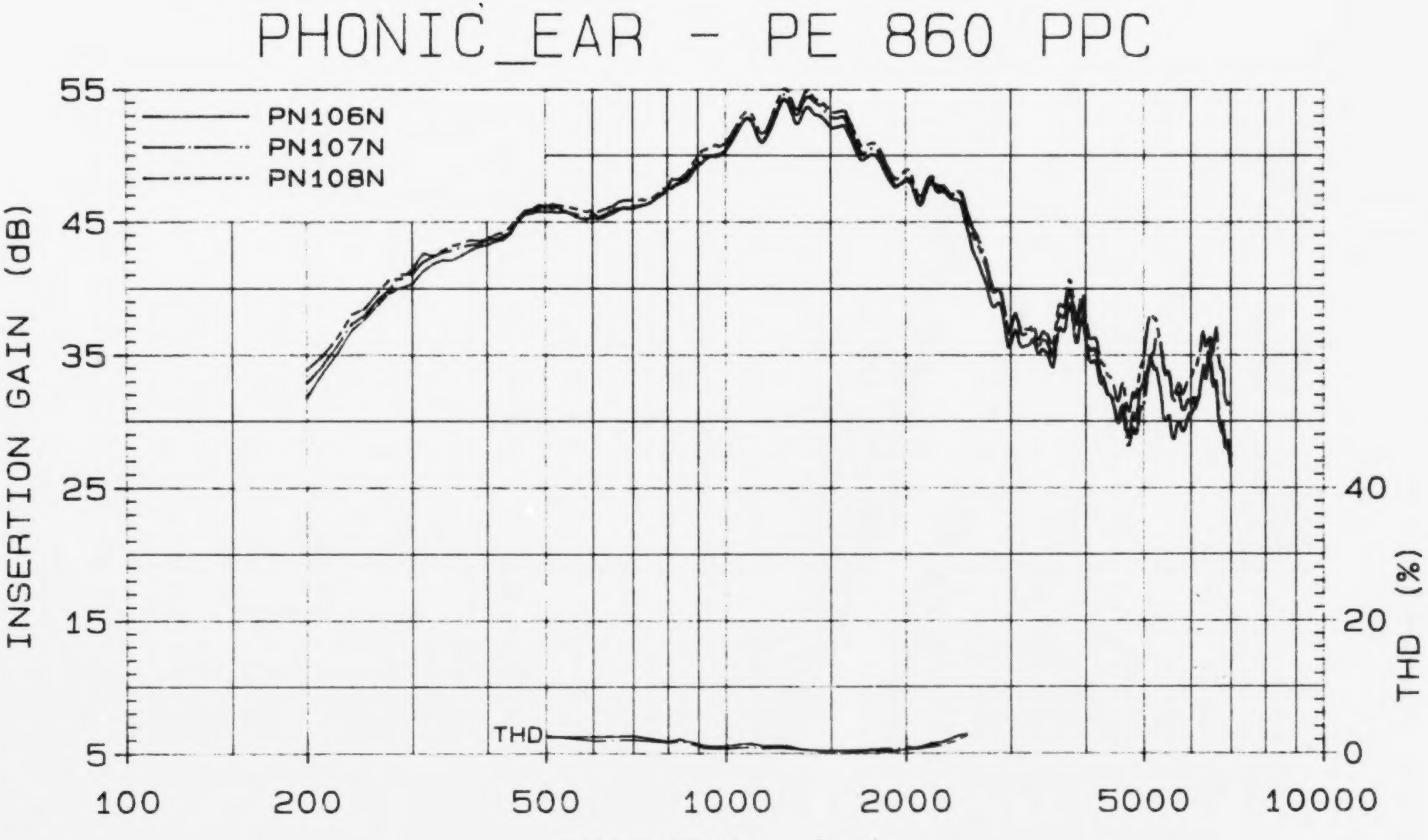
	PN106	PN107	PN108
Gain at 1kHz (dB)	49.5	49.5	50
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	2	3	3
800 Hz (%)	2	2	2
1600 Hz (%)	0	0	0
Maximum distortion above 800 Hz (%)	3	3	3
Freq. of max. (Hz)	2530	2530	2530
Equivalent input noise level (dB)	18	17	18
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	N.M.	N.M.	1.31

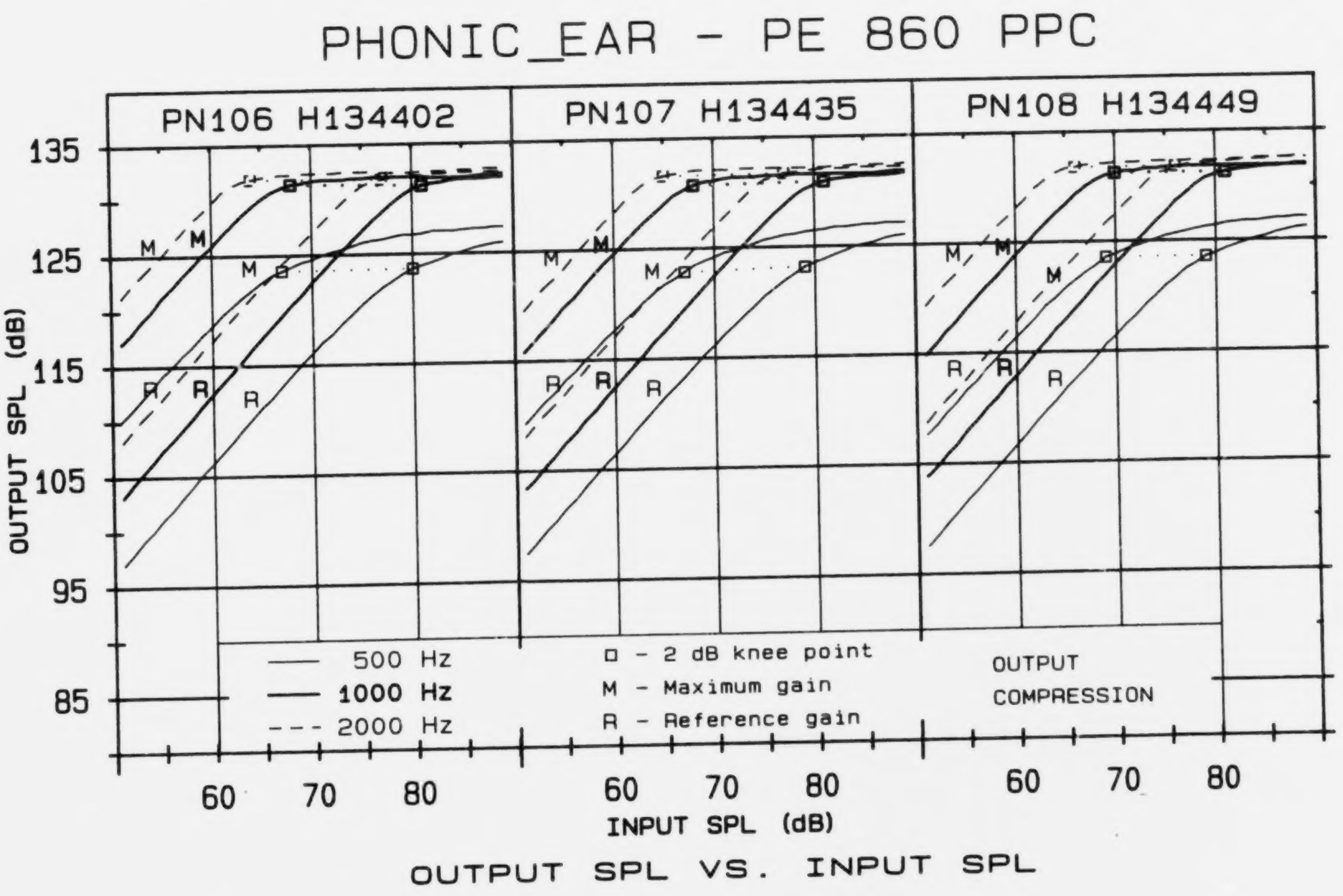
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
PN106	38	43	45.5	45.5	47	49.5	52	53	53	52
PN107	38.5	43.5	45.5	45.5	47	49.5	52	53	54	52.5
PN108	39	43.5	46	46	47.5	50	52.5	53.5	54	53

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
PN106	50	48	47.5	47	42	37	35.5	36	31.5	31
PN107	50.5	48	47.5	47	43.5	38	36.5	37	30.5	33.5
PN108	51	49	48	47.5	43	38	37	38	33	34.5

edb edb edb


PHONIC_EAR - PE 860 PPC
PN106N
PN107N
PN108N
THD
INSERTION GAIN (dB)
55
45
35
25
15
5
THD (%)
40
20
0
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)


PHONIC_EAR - PE 860 PPC
PN106 H134402
PN107 H134435
PN108 H134449
OUTPUT SPL (dB)
135
125
115
105
95
85
M
R
60
70
80
INPUT SPL (dB)
500 Hz
1000 Hz
2000 Hz
□ - 2 dB knee point
M - Maximum gain
R - Reference gain
OUTPUT
COMPRESSION
OUTPUT SPL VS. INPUT SPL

QUALITONE - CCED CO

SETTINGS - P:Red Dot H:Green Dot
BATTERY - 13

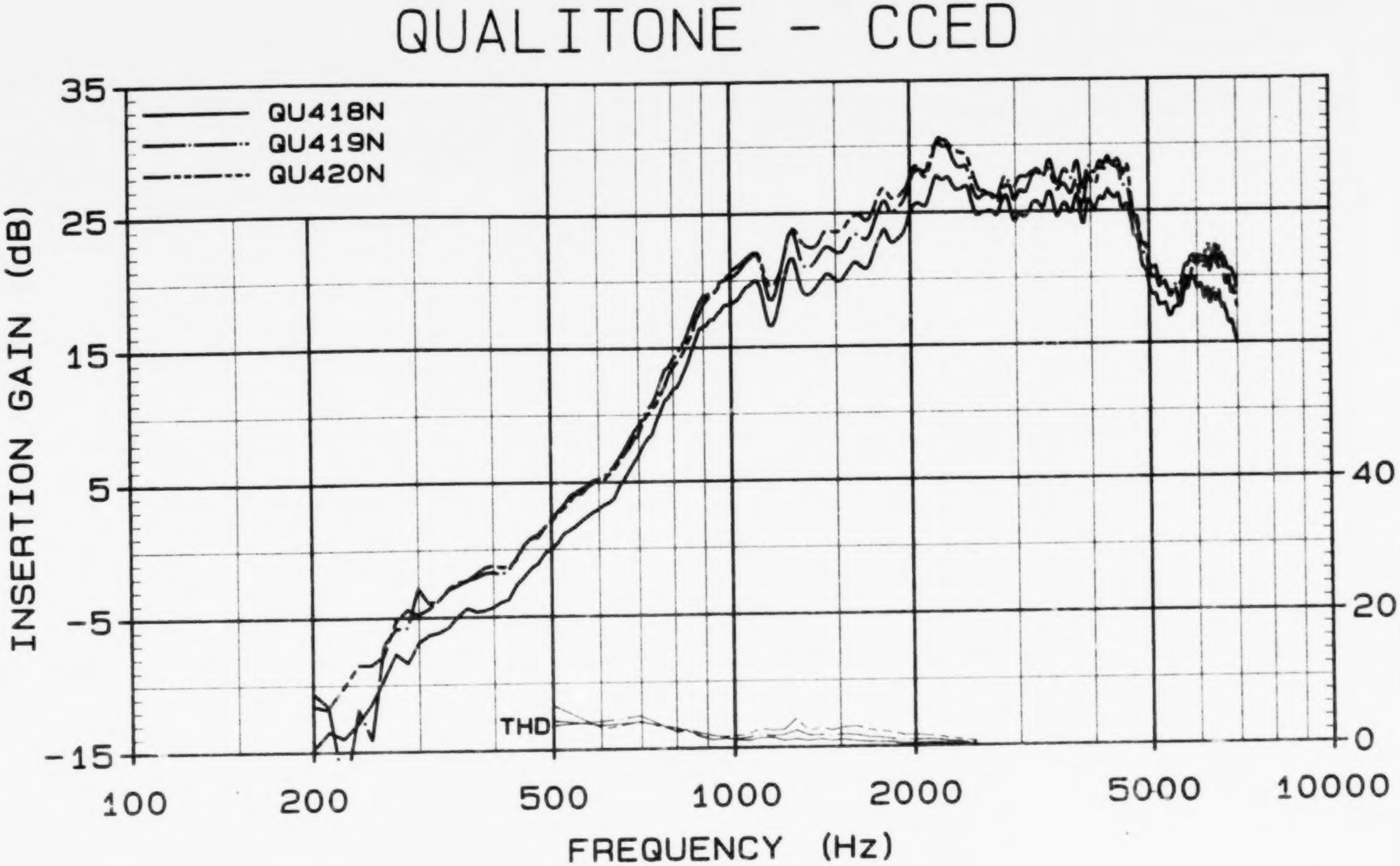
NBS CODE	QU418	QU419	QU420
SERIAL NO.	57770	57782	57762
DATE TESTED	5/11/88	5/11/88	6/9/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	35.5	34	37.5
SSPL for shaped noise signal (dB)	112	114	114
with input spl (dB)	68	66	66
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	17.5	19.5	19.5
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	4	4	6
800 Hz (%)	3	2	3
1600 Hz (%)	1	2	3
Maximum distortion above 800 Hz (%)	3	3	4
Freq. of max. (Hz)	830	1270	1270
Equivalent input noise level (dB)	24.5	28.5	24
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.35	1.34	1.33

Average insertion gain (dB) in 20 bands (center frequencies shown)

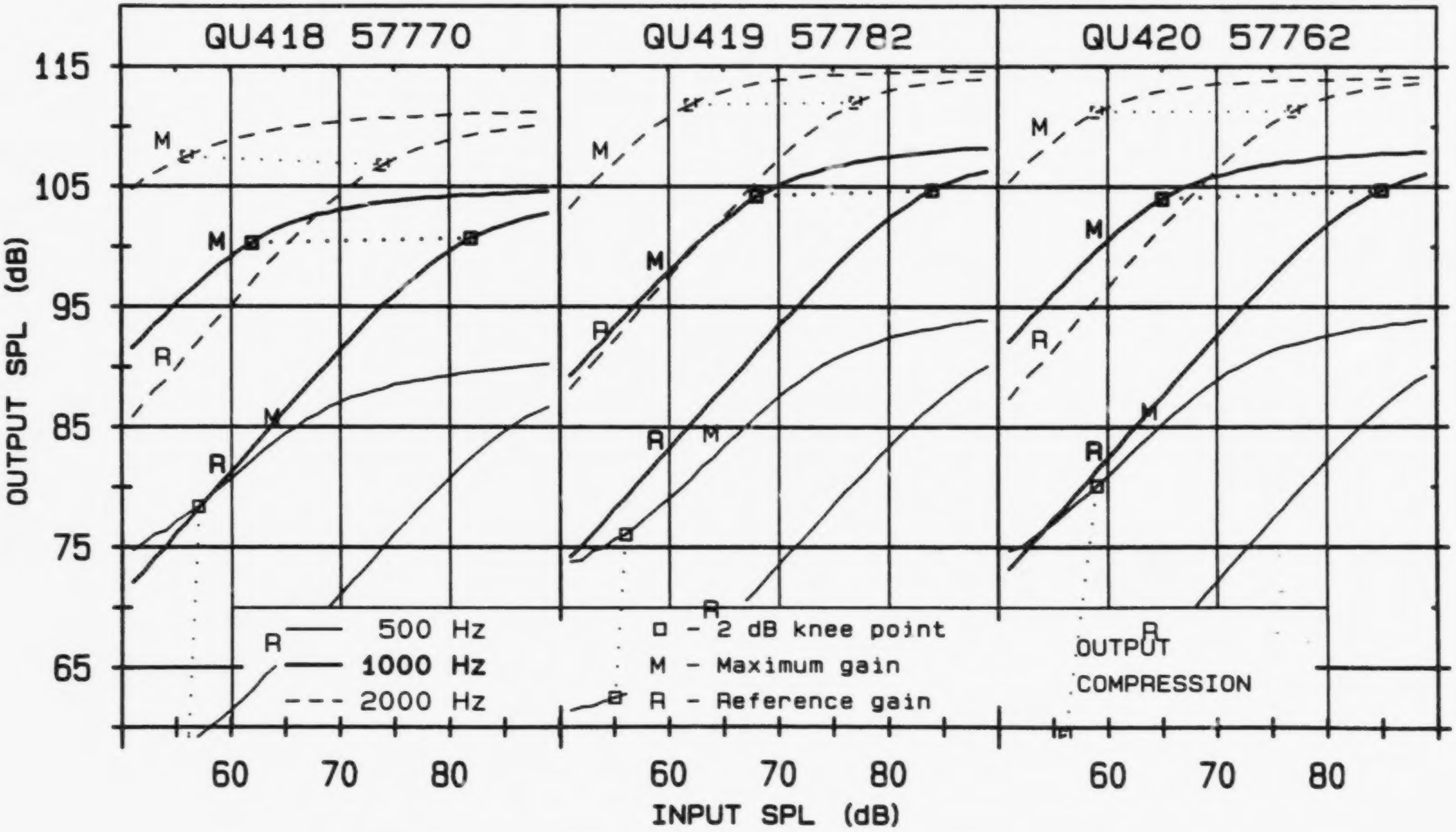
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
QU418	-10	-4.5	-0.5	4	10.5	16.5	19	19	19.5	20.5
QU419	-9	-2	2	6	12.5	19	21	21	21.5	22.5
QU420	-7	-2	2	6	12	18.5	21.5	21.5	23	24

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
QU418	22	23.5	26.5	27	25	25	25.5	25.5	24	18.5
QU419	24.5	26	29	29	26.5	27	28	28	25.5	20
QU420	25.5	26.5	28.5	30	27	27	27.5	27	26	19.5

ts ts edb


QUALITONE - CCED
QU418N
QU419N
QU420N
INSERTION GAIN (dB)
35
25
15
5
-5
-15
THD (%)
40
20
0
THD
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

QUALITONE - CCED



OUTPUT SPL VS. INPUT SPL

QUALITONE - DED

HP

SETTINGS - P:Red Dot H:Green Dot
BATTERY - 13

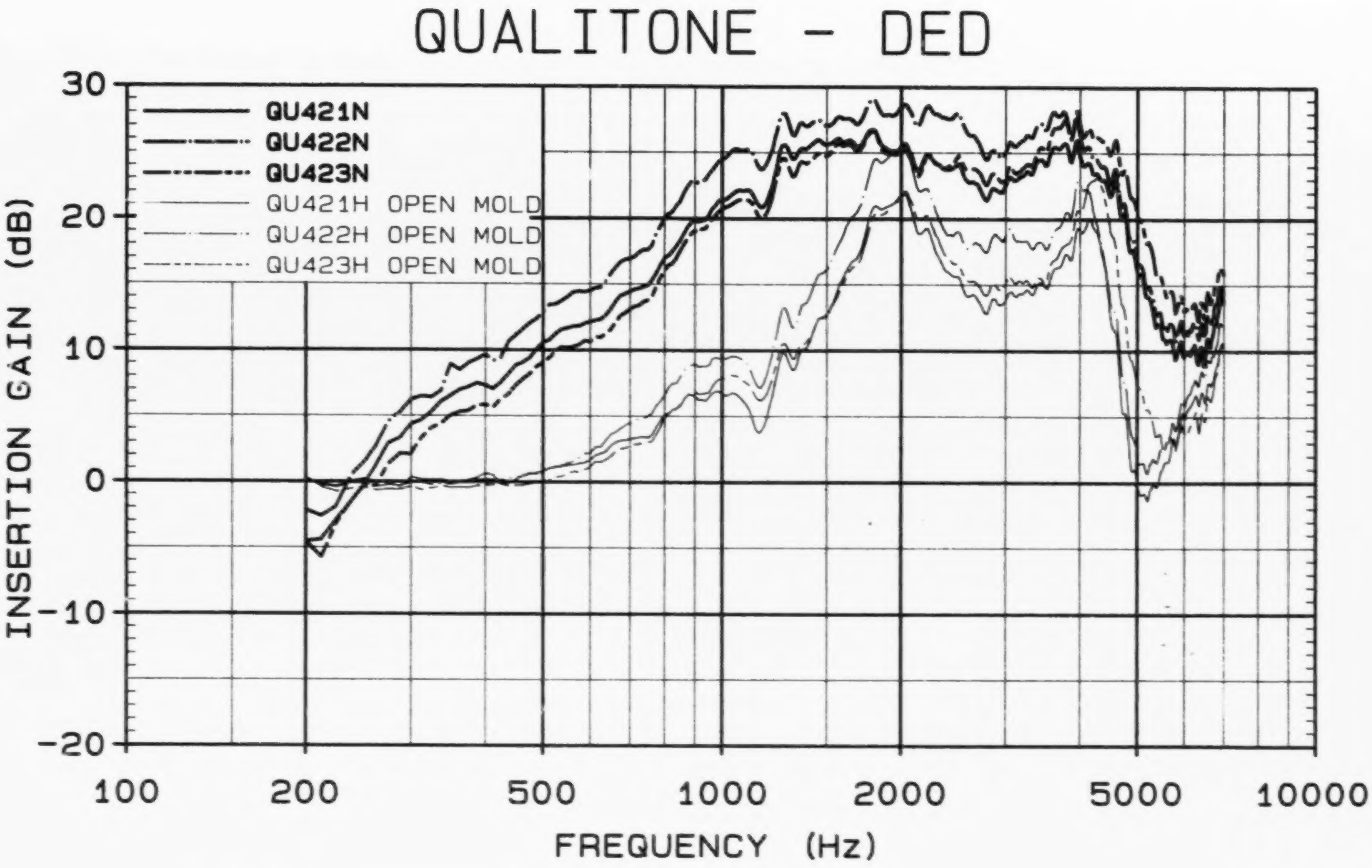
NBS CODE	QU421	QU422	QU423
SERIAL NO.	57943	57959	57950
DATE TESTED	4/25/88	4/25/88	4/25/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	21.5	24	20.5
SSPL for shaped noise signal (dB)	112.5	114	113
with input spl (dB)	82	80	82
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	21.5	24	20.5
Equivalent input noise level (dB)	17.5	17	18.5
Battery drain (mA)			
No input signal	0.3	0.3	N.M.
With shaped input noise level=65dB	0.4	0.4	N.M.
Battery voltage (V)	1.35	1.35	N.M.

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
QU421	1	7	10	13	16	20	22	23.5	25.5	26
QU422	2.5	9	12.5	15.5	18.5	23	25	26	27	27.5
QU423	0	5.5	9	11.5	15	19	21	22.5	24.5	25.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
QU421	26	25.5	24.5	24	22.5	22.5	24	25	20.5	12
QU422	28	28	28	28	26	25.5	27	26.5	21.5	13
QU423	26	25	24.5	24	23.5	23.5	25	27	24	16

edb ts ts ts


QUALITONE - DED
QU421N
QU422N
QU423N
QU421H OPEN MOLD
QU422H OPEN MOLD
QU423H OPEN MOLD
INSERTION GAIN (dB)
30
20
10
0
-10
-20
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

REXTON - M28CEH CO

SETTINGS - BASS CUT:0 COMP:0 GAIN:0
BATTERY - 675

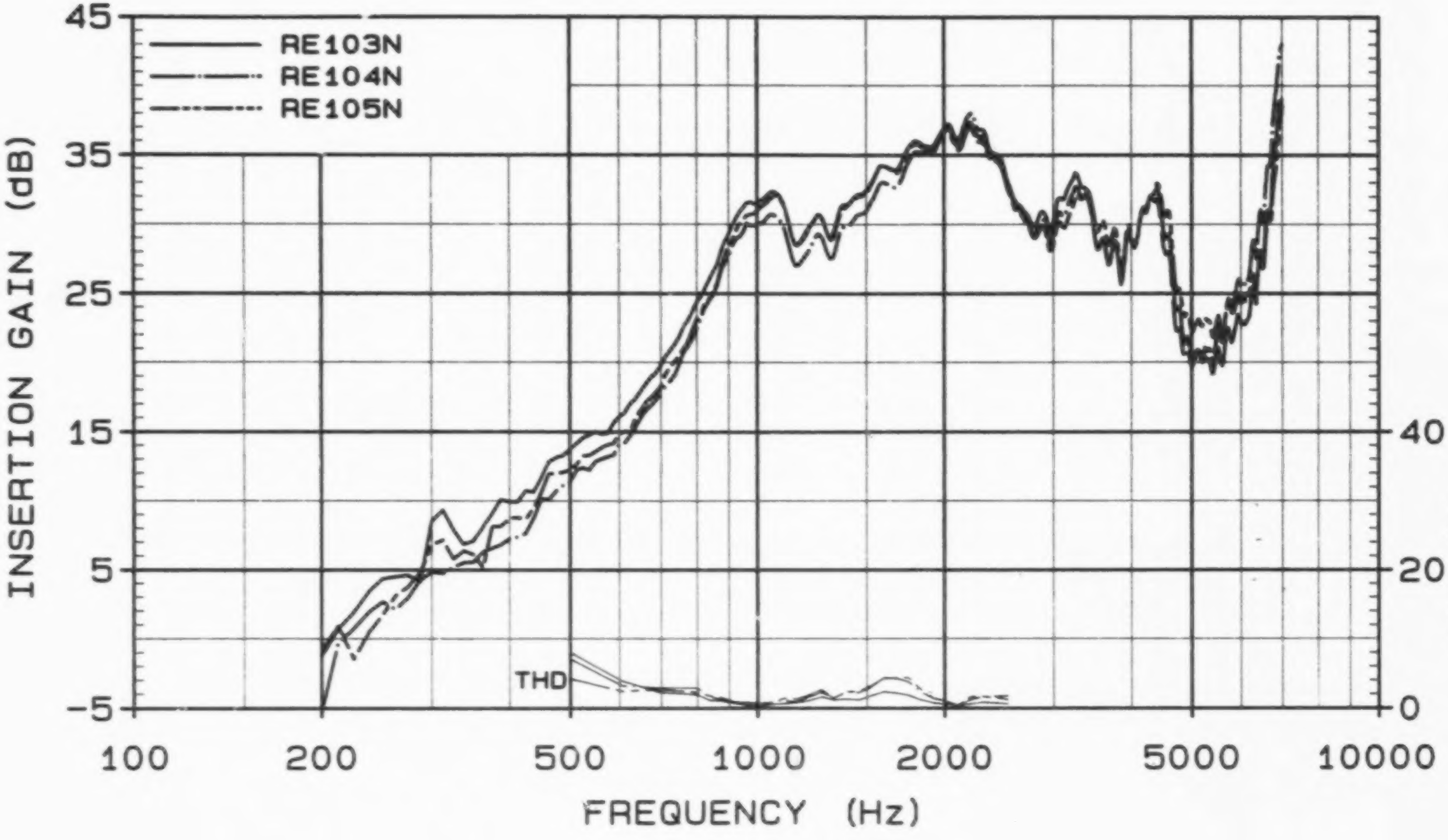
NBS CODE	RE103	RE104	RE105
SERIAL NO.	7EE607	7EE615	7EE623
DATE TESTED	6/13/88	6/14/88	6/14/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	45	36	39
SSPL for shaped noise signal (dB)	118.5	119	118.5
with input spl (dB)	94	70	68
Induction coil output level (dB)			
Self noise	62	62	61.5
Vertical field- 10 mA/m	75.5	80	87
Lateral field- 10 mA/m	63	66.5	65
Longitud field- 10 mA/m	75.5	85	85
Calculated maximum	80.5	87	89
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	24	28.5	30
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	8	7	4
800 Hz (%)	2	3	2
1600 Hz (%)	2	4	4
Maximum distortion above 800 Hz (%)	2	4	4
Freq. of max. (Hz)	1590	1590	1750
Equivalent input noise level (dB)	30.5	26	24.5
Battery drain (mA)			
No input signal	1.3	1.4	1.3
With shaped input noise level=65dB	1.3	1.4	1.3
Battery voltage (V)	1.31	1.32	1.32

Average insertion gain (dB) in 20 bands (center frequencies shown)

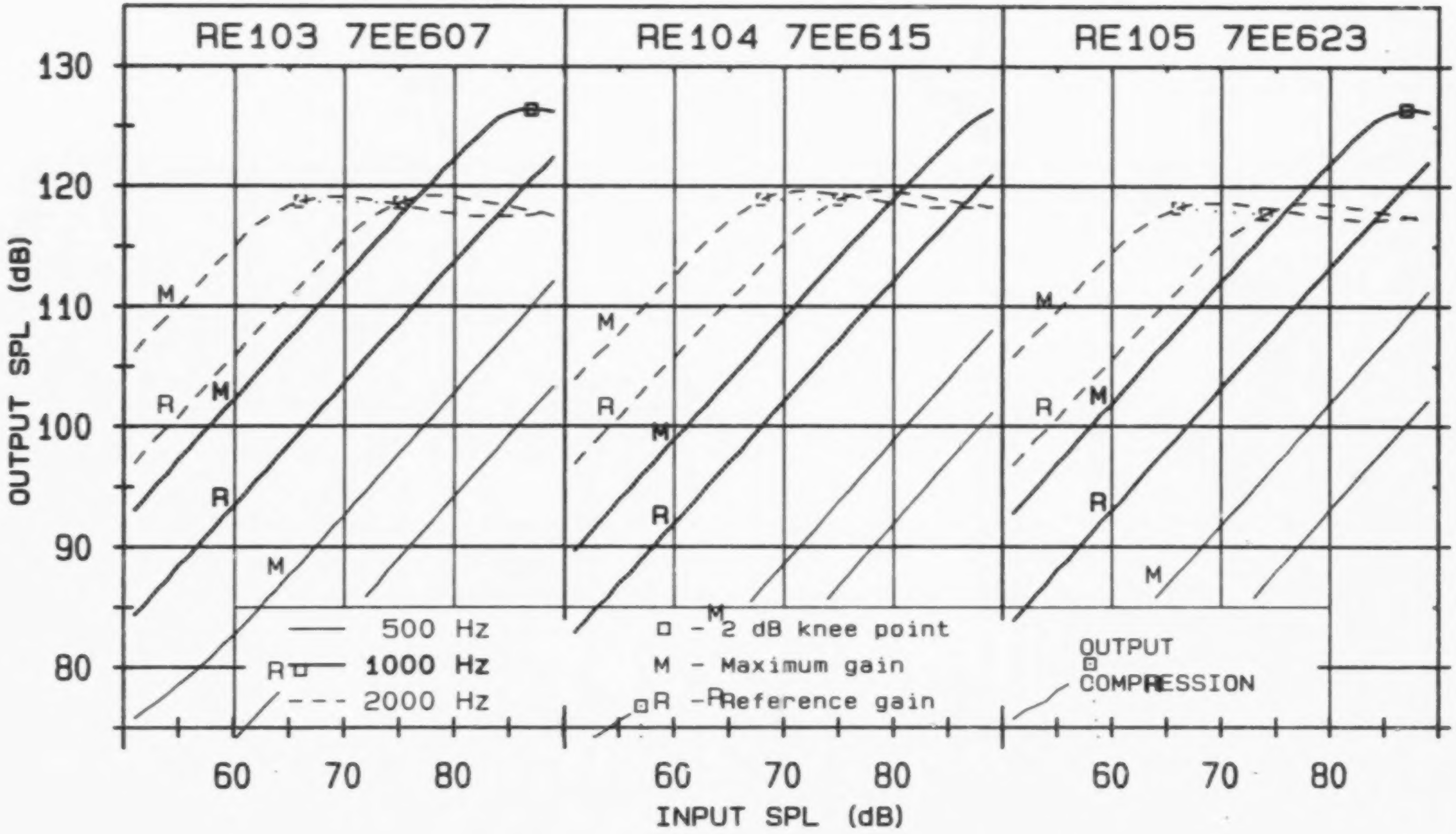
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
RE103	4.5	9	13.5	17	23	30	31.5	29.5	31	33.5
RE104	2	6.5	11	15	21	28	30	28	29.5	32.5
RE105	3	7.5	12	15.5	21.5	29	31.5	29.5	31	33.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
RE103	35	36	36.5	35.5	31.5	31	31	28.5	27	21
RE104	34	35.5	37	36	31	30	30.5	28.5	26	22.5
RE105	35	36	36.5	35	31	29.5	31	29	28	23
							edb	edb	edb	

REXTON - M28CEH



REXTON - M28CEH



OUTPUT SPL VS. INPUT SPL

REXTON - NOVA MASTER PP CO

SETTINGS - AGC:66 LOW:0 PC:0
BATTERY - 675

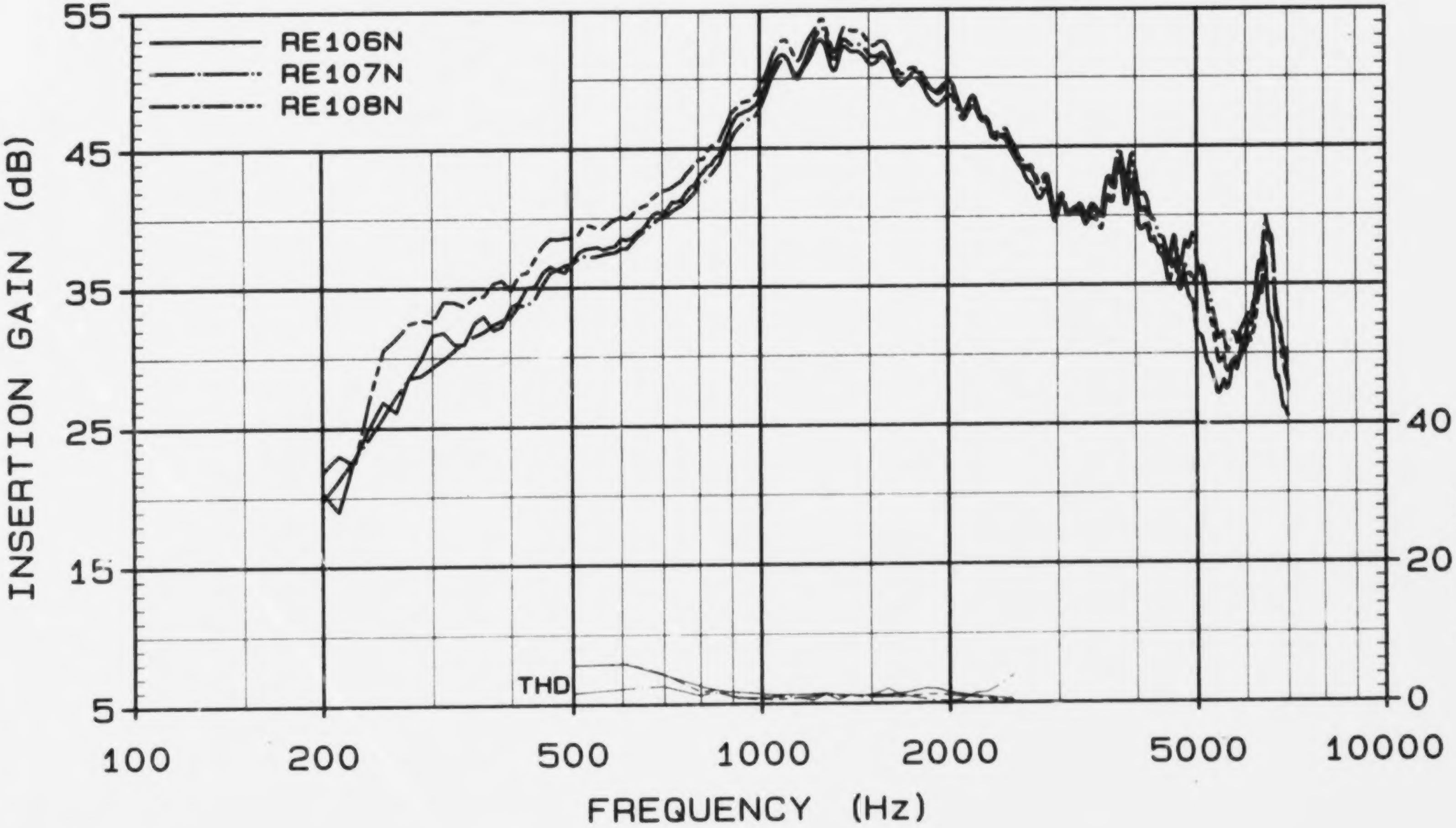
NBS CODE	RE106	RE107	RE108
SERIAL NO.	BCD199	BCD208	BCD223
DATE TESTED	6/13/88	6/13/88	6/13/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	63	63.5	63.5
SSPL for shaped noise signal (dB)	131	131	131.5
with input spl (dB)	70	62	72
Induction coil output level (dB)			
Self noise	84.5	84	87
Vertical field= 10 mA/m	110	108	107.5
Lateral field= 10 mA/m	90	87.5	86.5
Longitud field= 10 mA/m	93.5	91.5	92
Calculated maximum	110	108	108
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	49	46.5	49
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	6	2	6
800 Hz (%)	3	1	2
1600 Hz (%)	1	2	1
Maximum distortion above 800 Hz (%)	2	4	2
Freq. of max. (Hz)	1830	2530	830
Equivalent input noise level (dB)	20.5	19	19.5
Battery drain (mA)			
No input signal	0.9	0.8	0.8
With shaped input noise level=65dB	1.1	1.8	1.7
Battery voltage (V)	1.31	1.30	1.30

Average insertion gain (dB) in 20 bands (center frequencies shown)

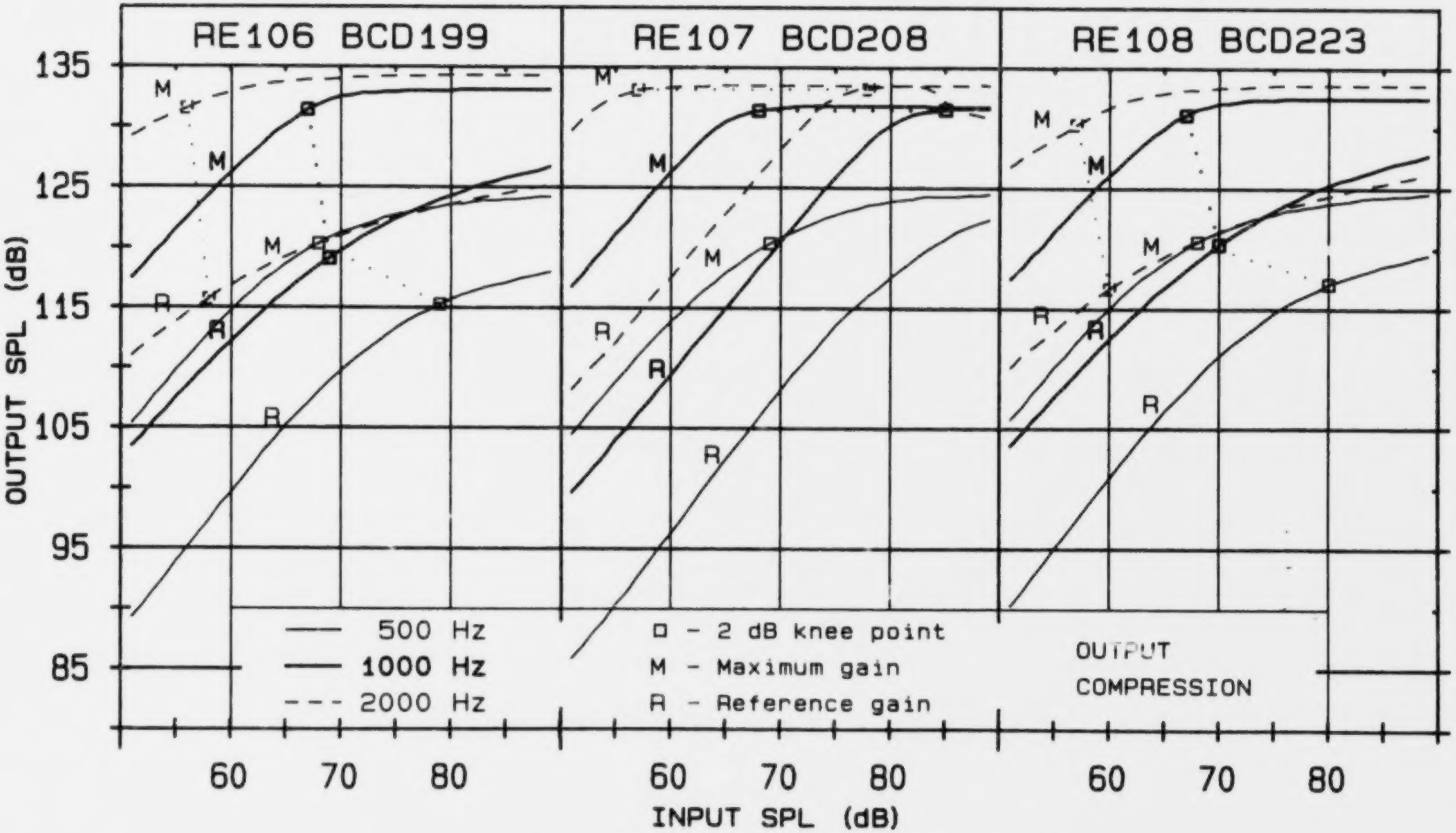
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
RE106	26.5	33	37	39	42	46.5	50.5	51.5	52	51
RE107	26	32.5	36.5	38.5	41.5	46	50	52.5	52.5	51.5
RE108	29.5	35	38.5	40.5	43.5	47.5	51.5	53	53	52.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
RE106	50	49.5	48.5	46.5	43	40.5	40.5	41	36	29
RE107	50	48.5	47.5	46	43.5	41	41	42.5	38	32.5
RE108	50.5	49	48	46.5	44	41.5	40	41.5	36	31
							edb	edb	edb	

REXTON - NOVA MASTER PP



REXTON - NOVA MASTER PP



OUTPUT SPL VS. INPUT SPL

REXTON - SELECTRA PP-6 CO

SETTINGS - AGC-I:BETWEEN 66 AND 70, ALL OTHER SLIDE TRIMMERS:FULL UP
BATTERY - 675

NBS CODE	RE100	RE101	RE102
SERIAL NO.	7HA803	7HA819	8AH351
DATE TESTED	6/13/88	6/13/88	6/13/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	*65	*65.5	*66
SSPL for shaped noise signal (dB)	132.5	133	132.5
with input spl (dB)	66	68	64
Induction coil output level (dB)			
Self noise	94	91	91.5
Vertical field= 10 mA/m	121.5	122.5	123.5
Lateral field= 10 mA/m	110	96	102
Longitud field= 10 mA/m	118.5	117.5	117
Calculated maximum	123.5	123.5	124.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	50	52	50.5
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	16	5	5
800 Hz (%)	5	1	1
1600 Hz (%)	1	1	0
Maximum distortion above 800 Hz (%)	4	2	2
Freq. of max. (Hz)	830	2410	2410
Equivalent input noise level (dB)	23.5	21.5	22
Battery drain (mA)			
No input signal	1.0	1.0	1.0
With shaped input noise level=65dB	2.0	1.2	2.1
Battery voltage (V)	1.32	1.32	1.30

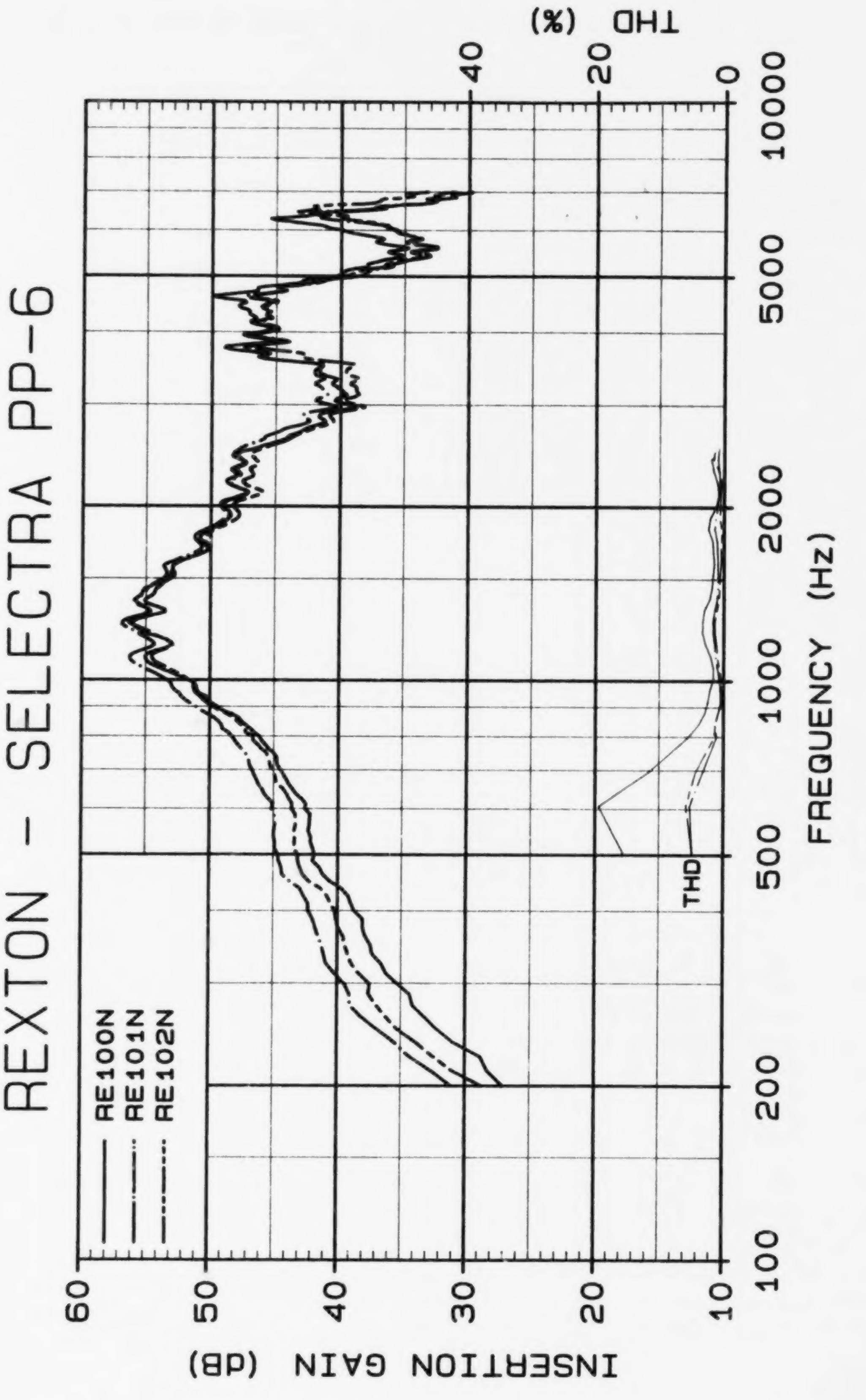
Average insertion gain (dB) in 20 bands (center frequencies shown)

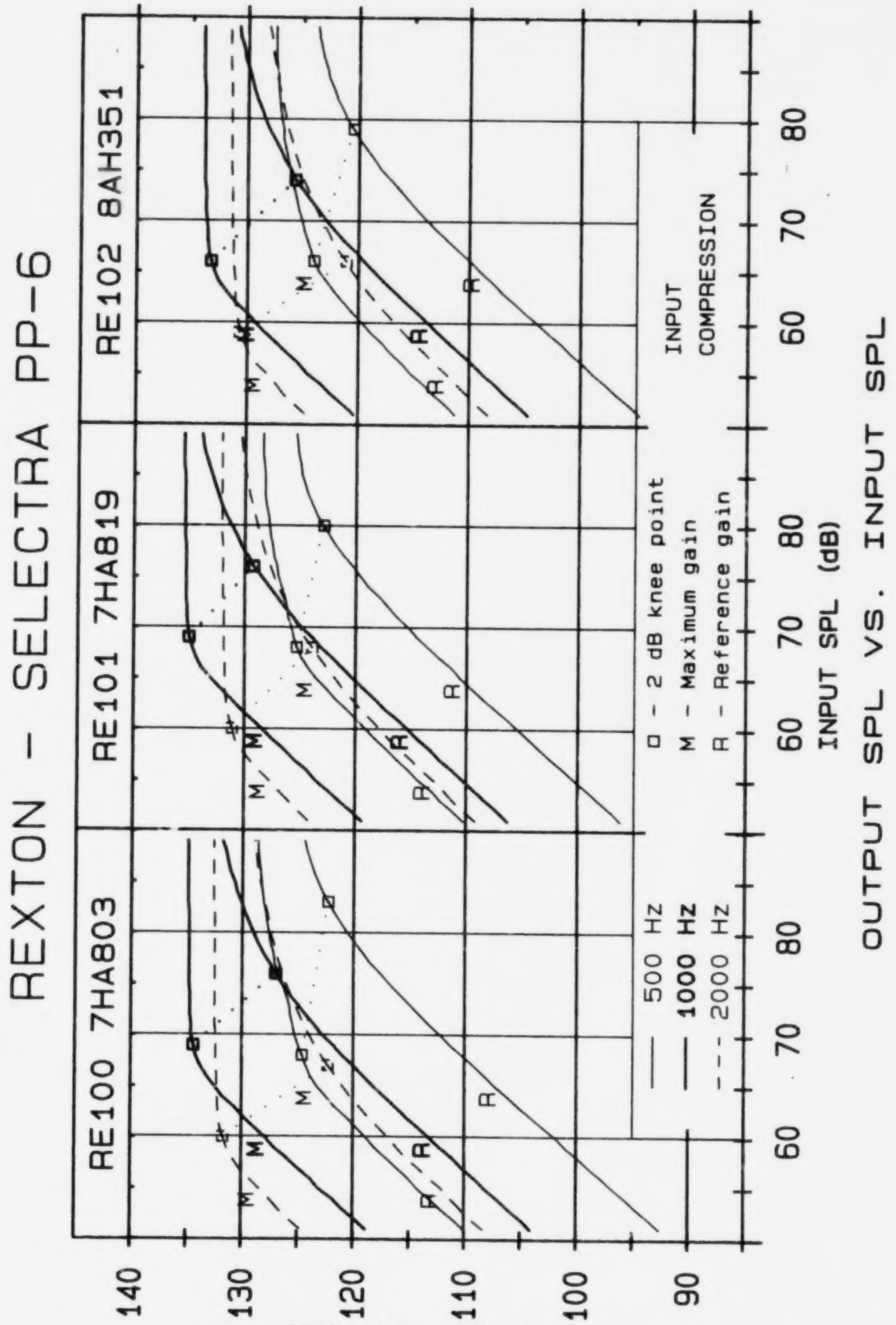
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
RE100	32.5	38	41.5	43	45.5	49.5	54	55	54.5	52.5
RE101	37	42	44.5	45.5	48	51.5	55	55.5	55	53
RE102	35	40	43	44	46	50	53.5	55	55	52.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
RE100	50.5	49	48	48	44	40	42	46.5	46	37
RE101	51	49	48	48	45.5	41.5	42.5	46	44.5	34.5
RE102	50	48	47	46.5	43.5	39.5	40	45.5	44.5	35

* The maximum gain was reduced because of feedback

edb
edb edb


REXTON - SELECTRA PP-6


REXTON - SELECTRA PP-6

OUTPUT SPL VS. INPUT SPL

SIEMENS - 268-S **HP**

SETTINGS - PC:0 TONE:H
BATTERY - 13

NBS CODE	SI316	SI317	SI318
SERIAL NO.	S02228	S02237	S02296
DATE TESTED	5/6/88	5/6/88	5/6/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	26.5	26	28
SSPL for shaped noise signal (dB)	114.5	114	114.5
with input spl (dB)	76	74	74
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	23.5	22	24
Equivalent input noise level (dB)	22	23	23
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.33	1.33	1.33

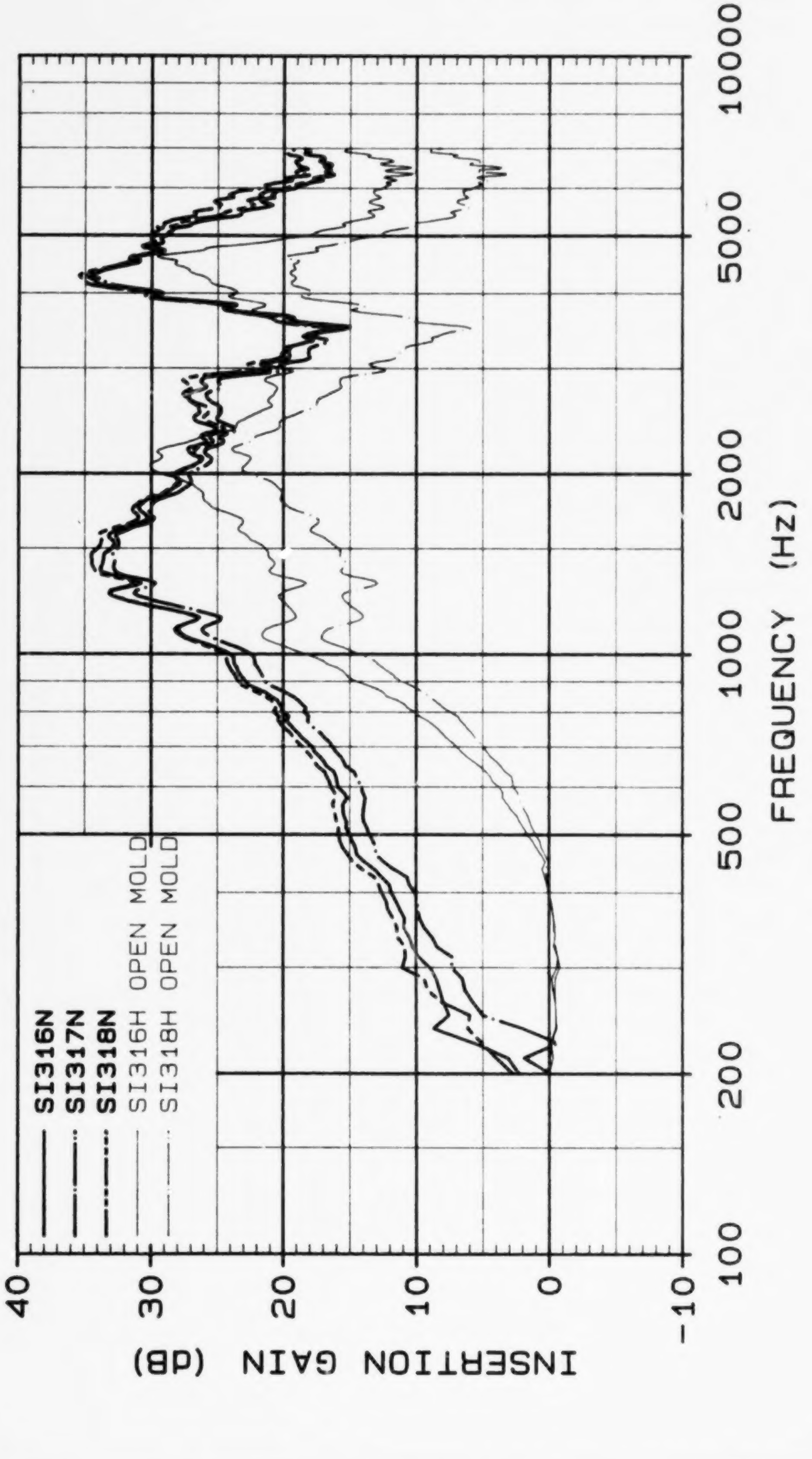
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
SI316	7.5	11.5	15	16.5	19.5	23	26.5	30.5	33	32.5
SI317	4.5	10	13.5	14.5	18	21.5	25	29	32	32
SI318	7.5	12	15.5	17	20	23.5	27	30.5	33.5	33.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
SI316	30.5	28.5	27	26	26.5	22.5	18	28	31	23.5
SI317	30	27.5	26	24.5	25	21	18	28	31.5	26.5
SI318	31	28.5	26.5	25.5	26.5	23.5	18	29	31.5	24.5

ts ts ts

SIEMENS - 268-S



SIEMENS - 284-PP-AGC-I CO

SETTINGS - PC:0 AGC:60 N/L:N N/H:H
BATTERY - 675

NBS CODE	SI313	SI314	SI315
SERIAL NO.	S06308	S06310	S06336
DATE TESTED	5/13/88	5/13/88	5/13/88

DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING

Gain at 1kHz (dB)	62.5	65	47.5
SSPL for shaped noise signal (dB)	126	128	125.5
with input spl (dB)	80	80	80
Induction coil output level (dB)			
Self noise	73	74.5	72
Vertical field- 10 mA/m	96	100	100
Lateral field- 10 mA/m	91	91.5	86
Longitud field- 10 mA/m	100	100	100
Calculated maximum	102	103.5	103

DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING

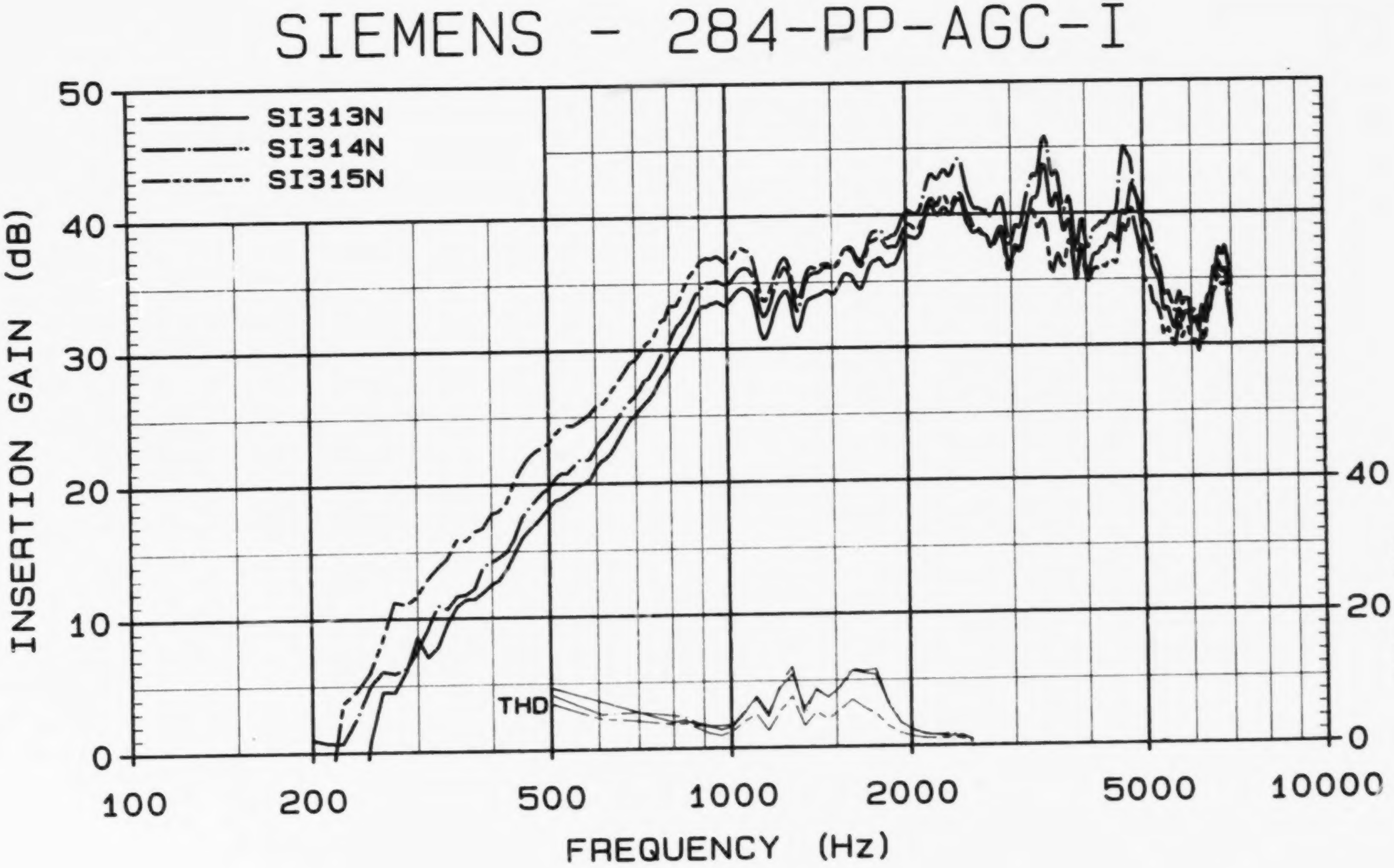
Gain at 1kHz (dB)	34.5	35	36
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	9	8	7
800 Hz (%)	4	5	4
1600 Hz (%)	11	12	7
Maximum distortion above 800 Hz (%)	11	12	8
Freq. of max. (Hz)	1590	1270	1270
Equivalent input noise level (dB)	28.5	28	25.5
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.35	1.35	1.35

Average insertion gain (dB) in 20 bands (center frequencies shown)

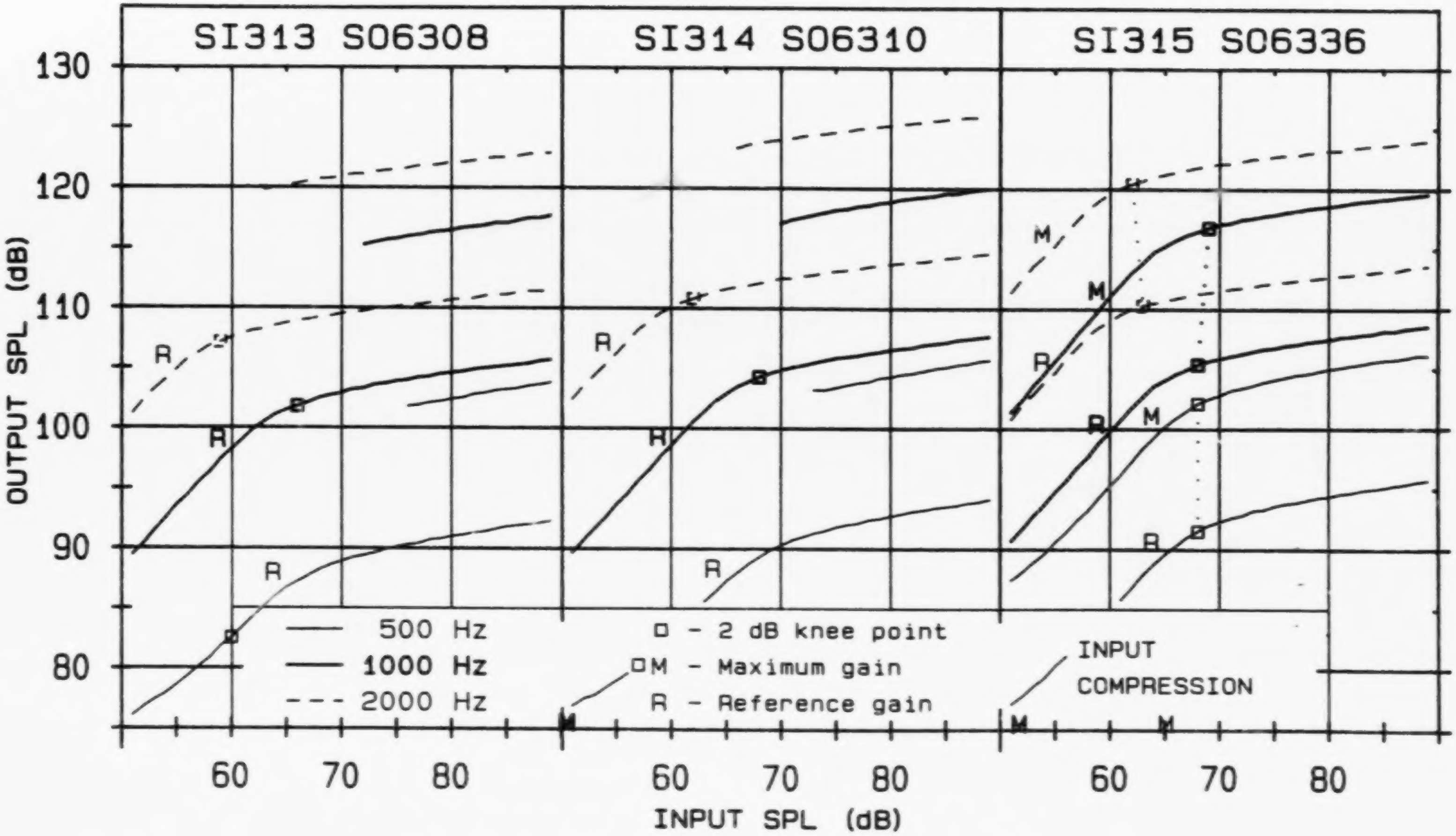
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
SI313	1.5	12	17.5	22	27.5	33	33.5	32.5	33.5	35
SI314	5	13	19.5	23.5	29.5	34.5	35	34.5	35	37
SI315	7	17	23	26.5	31.5	36.5	36.5	35.5	35.5	37

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
SI313	36	37	39.5	40.5	38.5	38	41.5	37	39.5	33.5
SI314	38	39	41.5	43.5	40.5	39.5	43.5	39	41.5	35
SI315	37.5	38	40	41	39	37.5	38	36	37.5	31.5

ts ts ts


SIEMENS - 284-PP-AGC-I
SI313N
SI314N
SI315N
INSERTION GAIN (dB)
50
40
30
20
10
0
THD
THD (%)
40
20
0
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

SIEMENS - 284-PP-AGC-I



OUTPUT SPL VS. INPUT SPL

SIEMENS - 284-PP-ASP **ASP**

SETTINGS - PC:0 A:MAX F:14 G:15
BATTERY - 675

NBS CODE	SI310	SI311	SI312
SERIAL NO.	C03629	C03295	C03690
DATE TESTED	6/27/88	6/27/88	6/27/88

DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING

Gain at 1kHz (dB)	44	47.5	44.5
SSPL for shaped noise signal (dB)	127	129.5	129.5
with input spl (dB)	70	68	70
Induction coil output level (dB)			
Self noise	88.5	89.5	89
Vertical field= 10 mA/m	97.5	97	97.5
Lateral field= 10 mA/m	94	97.5	95
Longitud field= 10 mA/m	98.5	103	101.5
Calculated maximum	102	105	103.5

DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING

Gain at 1kHz (dB)	33	37	35
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	10	7	14
800 Hz (%)	5	5	7
1600 Hz (%)	1	2	1
Maximum distortion above 800 Hz (%)	3	3	3
Freq. of max. (Hz)	830	1150	1150
Equivalent input noise level (dB)	33.5	32.5	33
Battery drain (mA)			
No input signal	0.9	0.9	0.9
With shaped input noise level=65dB	1.6	1.8	1.6
Battery voltage (V)	1.33	1.33	1.33

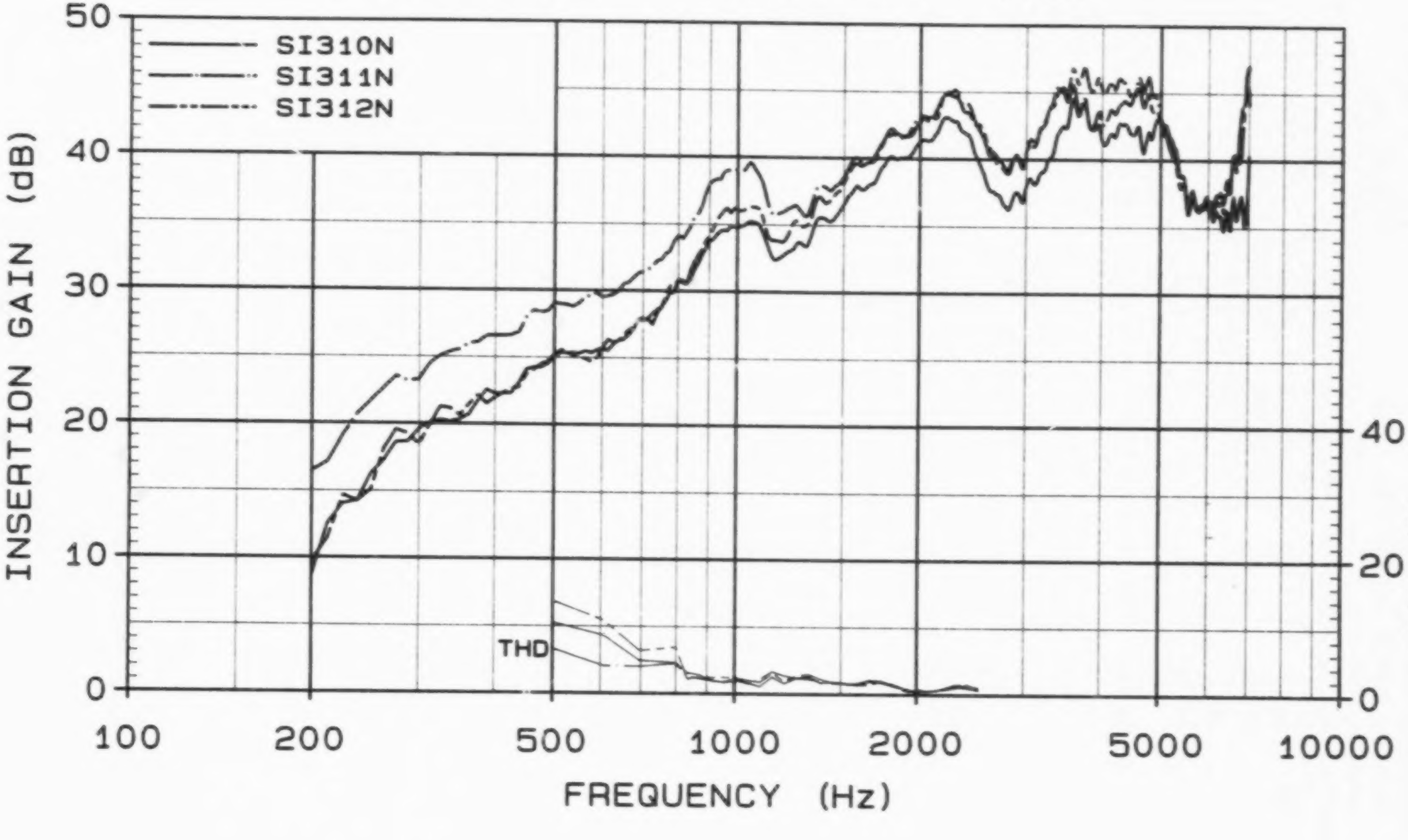
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
SI310	16.5	21.5	24.5	26	29.5	33.5	34.5	33	35.5	37.5
SI311	21.5	26	28.5	30	33	38	38.5	36	37.5	39.5
SI312	16.5	21.5	24.5	26	29.5	34.5	35.5	34.5	36.5	39

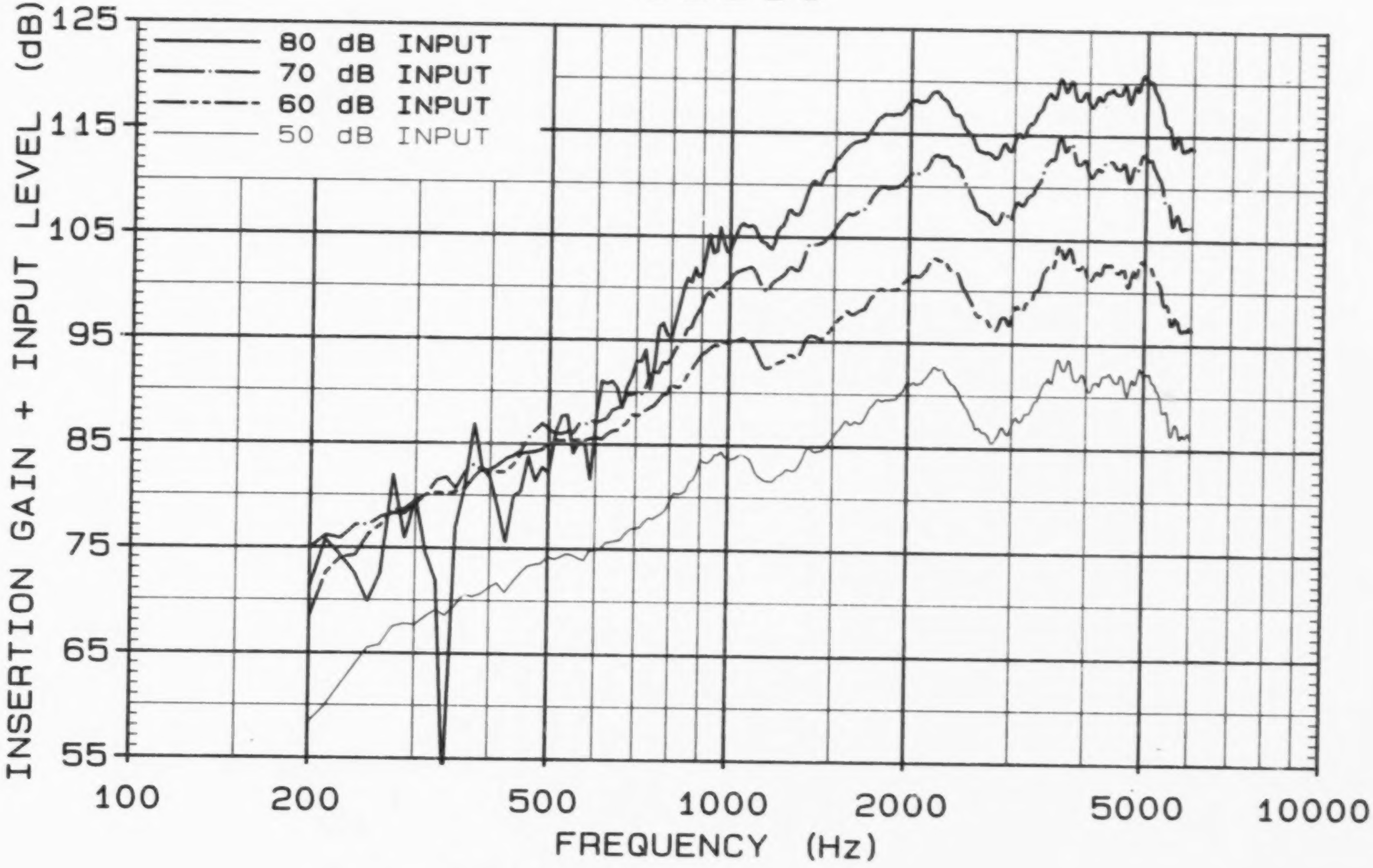
Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
SI310	39.5	40.5	42	42	37.5	38	42	42.5	42	38.5
SI311	41.5	42	44	44	40	40.5	44.5	43.5	45	38.5
SI312	41	42	43.5	43.5	40.5	41	45	45.5	44.5	38

edb edb edb

SIEMENS - 284-PP-ASP



SI310


80 dB INPUT
70 dB INPUT
60 dB INPUT
50 dB INPUT
INSERTION GAIN + INPUT LEVEL (dB)
125
115
105
95
85
75
65
55
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

SIEMENS - 303-ASP ASP

SETTINGS - PC:0 N/H:H
BATTERY - 13

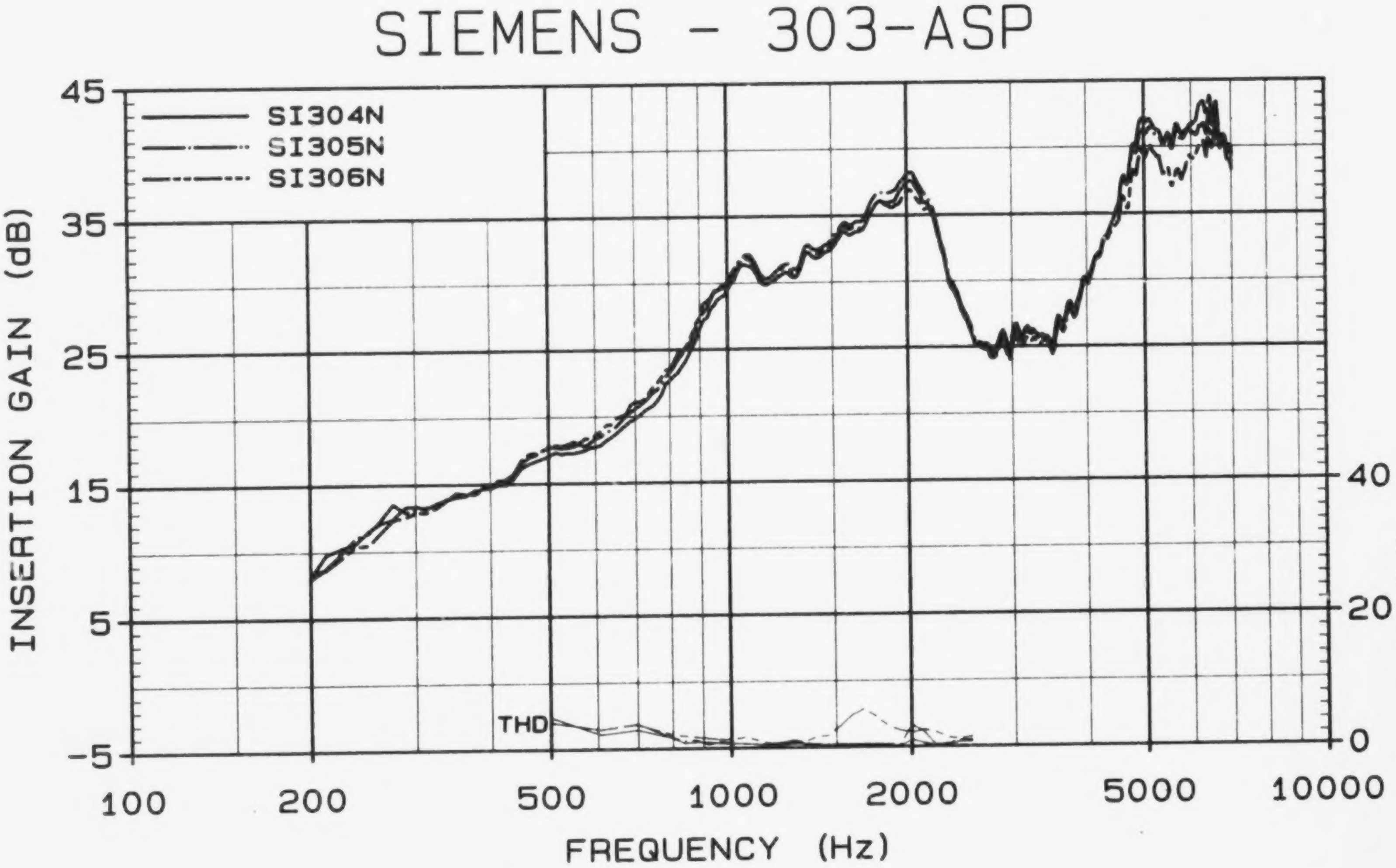
NBS CODE	SI304	SI305	SI306
SERIAL NO.	A05016	A05085	A05130
DATE TESTED	6/24/88	6/28/88	6/28/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	34	36	36
SSPL for shaped noise signal (dB)	118.5	119	118
with input spl (dB)	72	72	76
Induction coil output level (dB)			
Self noise	61.5	62.5	62
Vertical field- 10 mA/m	91.5	94	94
Lateral field- 10 mA/m	73	71.5	81
Longitud field- 10 mA/m	83	80	83
Calculated maximum	92	94.5	94.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	29	29.5	30
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	5	4	4
800 Hz (%)	2	2	2
1600 Hz (%)	0	0	5
Maximum distortion above 800 Hz (%)	1	3	6
Freq. of max. (Hz)	2010	2010	1670
Equivalent input noise level (dB)	28.5	29	34
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	N.M.	N.M.	N.M.

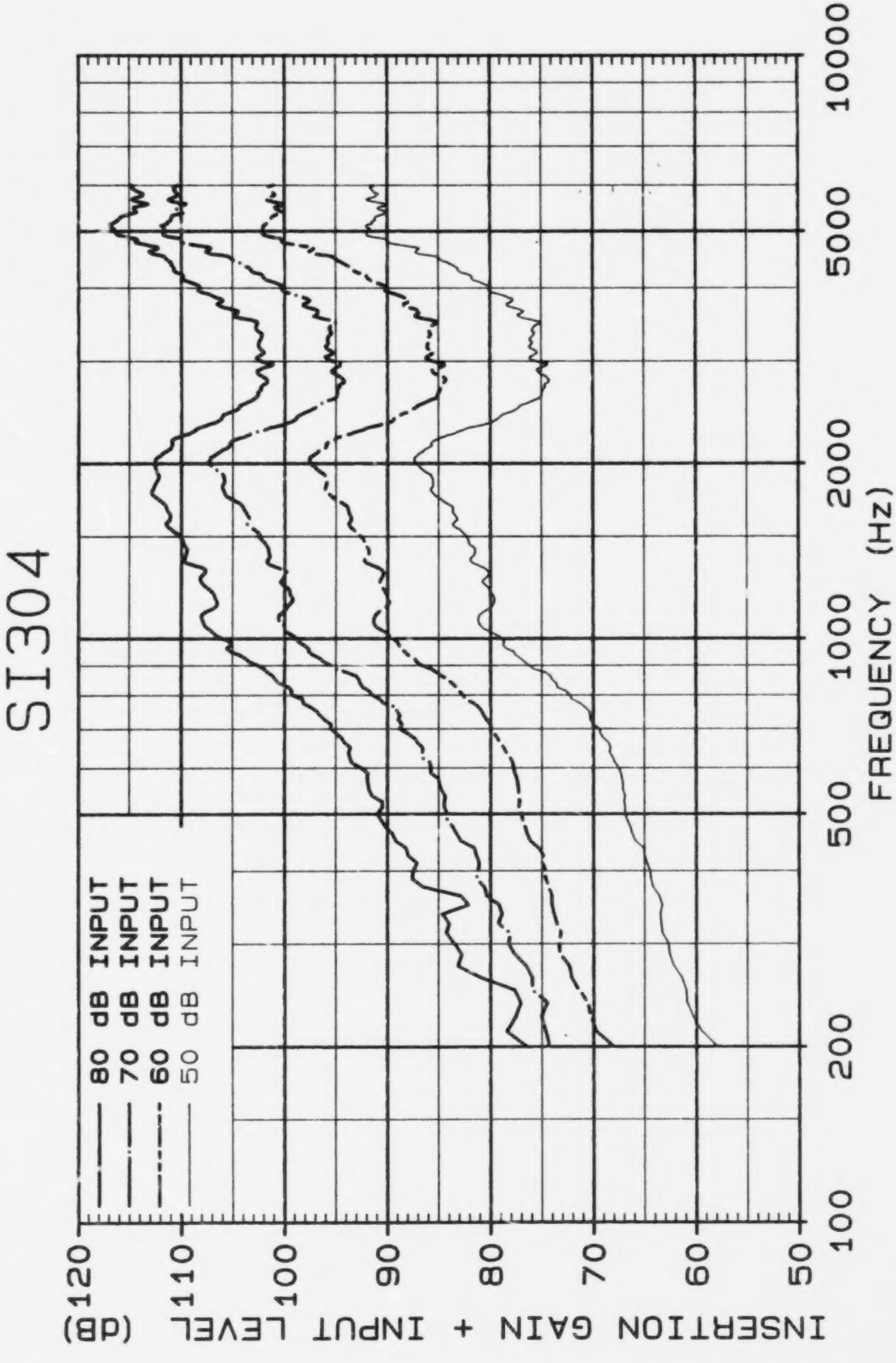
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
SI304	11.5	14.5	17	18.5	21.5	27	30.5	30.5	32	33.5
SI305	11.5	14.5	17.5	19	22.5	28	31.5	31	32.5	34
SI306	11	14.5	17.5	19.5	23	28	31	30.5	32	34

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
SI304	35	36.5	36	30	25	25.5	26	29.5	37.5	41
SI305	36	37	36.5	30.5	25.5	26	25.5	29	37.5	41
SI306	35	36	35.5	30.5	25.5	25	25.5	29.5	36	38.5

edb edb edb


SIEMENS - 303-ASP
SI304N
SI305N
SI306N
INSERTION GAIN (dB)
45
35
25
15
5
-5
THD
THD (%)
40
20
0
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)


SI304
80 dB INPUT
70 dB INPUT
60 dB INPUT
50 dB INPUT
INSERTION GAIN + INPUT LEVEL (dB)
120
110
100
90
80
70
60
50
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

SIEMENS - 304-PP-AGC-I CO

SETTINGS - PC:0 N/H:H AI:65
BATTERY - 13

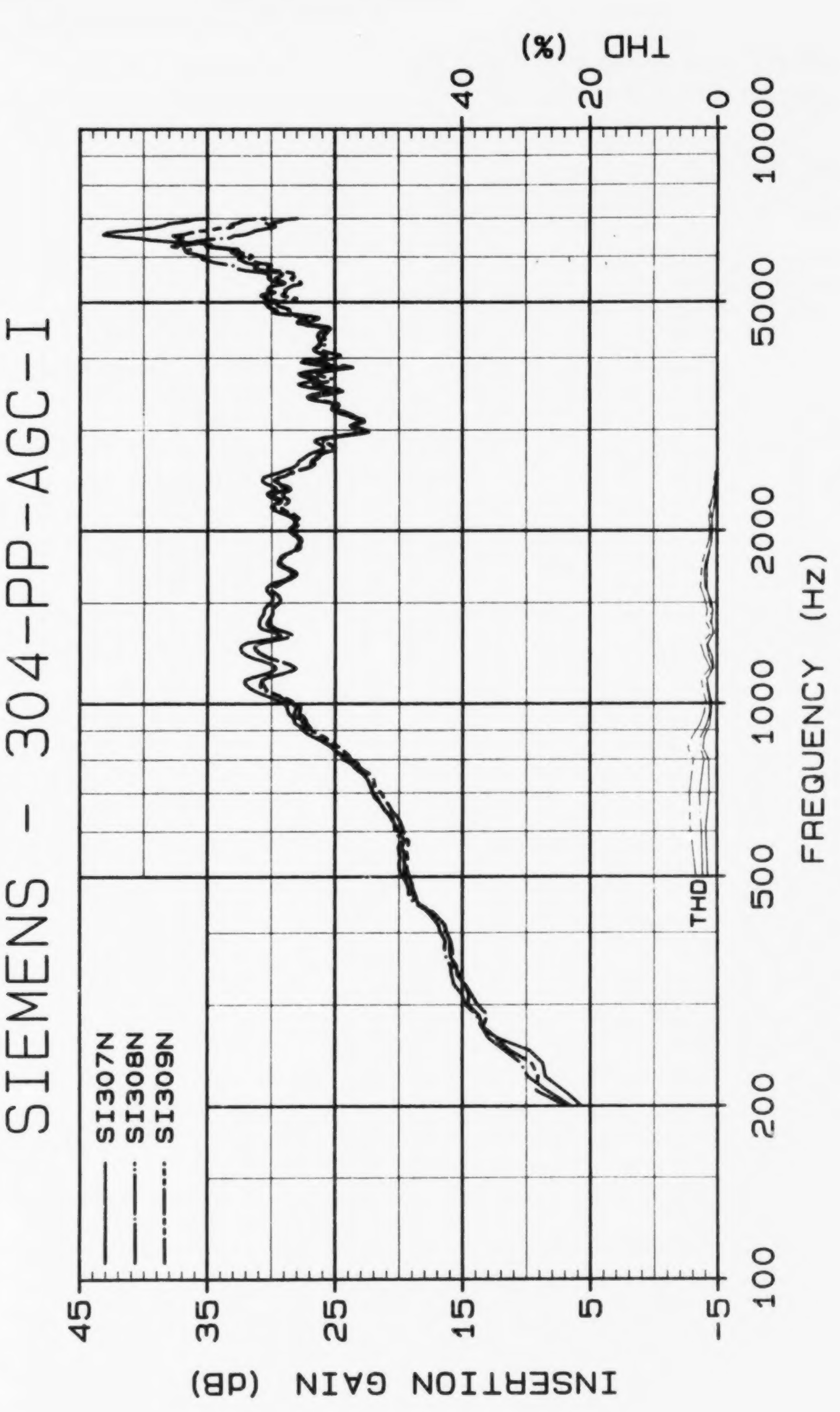
NBS CODE	SI307	SI308	SI309
SERIAL NO.	A01405	A01409	A01469
DATE TESTED	5/13/88	5/13/88	5/13/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	39.5	40	40
SSPL for shaped noise signal (dB)	115	114.5	114
with input spl (dB)	82	84	82
Induction coil output level (dB)			
Self noise	65	64	63.5
Vertical field- 10 mA/m	94.5	89	94
Lateral field- 10 mA/m	72.5	68.5	69.5
Longitud field- 10 mA/m	78.5	75.5	73
Calculated maximum	95	90	94
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	29	29.5	29
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	2	2	3
800 Hz (%)	1	2	4
1600 Hz (%)	2	2	3
Maximum distortion above 800 Hz (%)	2	3	5
Freq. of max. (Hz)	830	830	830
Equivalent input noise level (dB)	27.5	26.5	26
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level-65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.35	1.35	1.35

Average insertion gain (dB) in 20 bands (center frequencies shown)

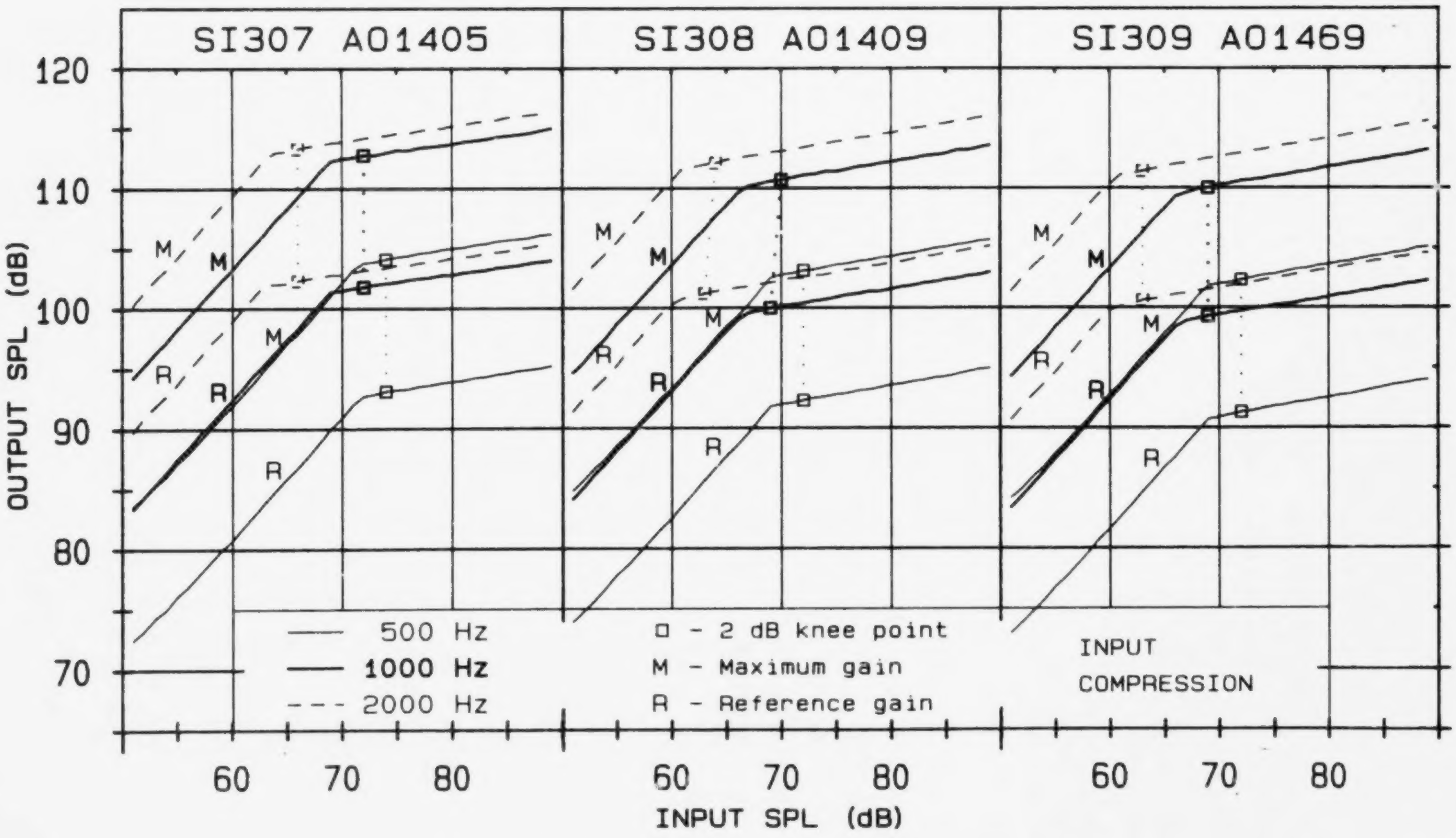
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
SI307	11	16	19	20.5	23.5	27.5	31	31	30.5	30
SI308	12	16.5	19.5	20.5	23.5	27.5	30	30	29.5	29.5
SI309	11.5	16	19	20	23	27	29.5	30	29.5	29.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
SI307	29	28	29	30	27.5	24.5	26	26.5	27	30.5
SI308	29	28	29	29.5	26.5	24	25.5	25.5	28	31.5
SI309	29	28	28.5	29	26.5	24	25.5	26.5	28	29

ts ts ts


SIEMENS - 304-PP-AGC-I
SI307N
SI308N
SI309N
INSERTION GAIN (dB)
45
35
25
15
5
-5
THD (%)
40
20
0
THD
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

SIEMENS - 304-PP-AGC-I



OUTPUT SPL VS. INPUT SPL

TELEX - 340 CLO (Wireless) CROS **CR**

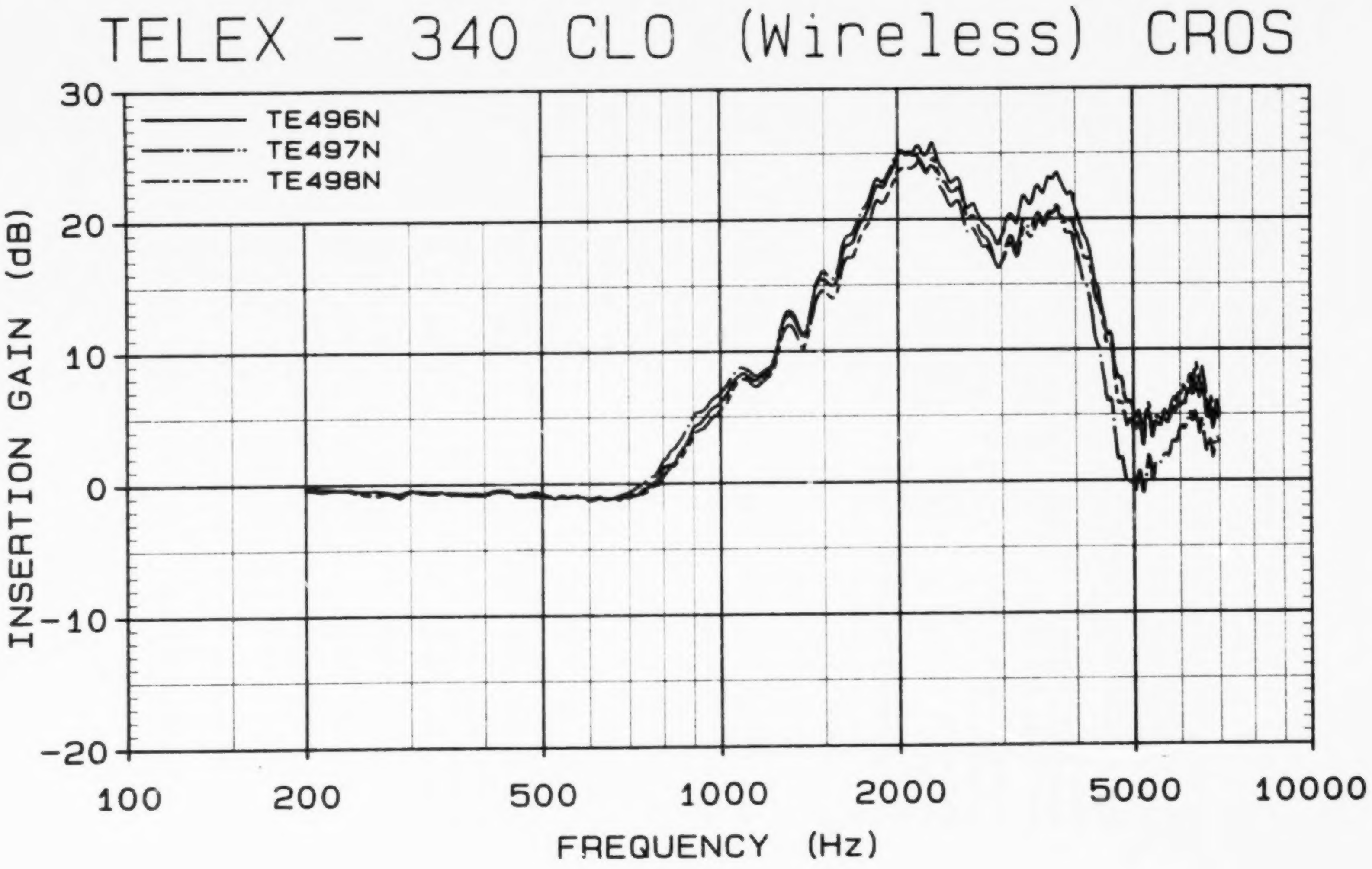
SETTINGS - Normal Output:0
BATTERY - 675

NBS CODE	TE496	TE497	TE498
SERIAL NO.	8820211	8820222	8820227
DATE TESTED	6/20/88	6/20/88	6/20/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	12.5	13.5	12.5
SSPL for shaped noise signal (dB)	108	108	108
with input spl (dB)	72	72	70
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	6	6.5	5
Equivalent input noise level (dB)	20.5	21	21
Battery drain (mA)			
No input signal	0.4,1.2	0.4,1.2	0.4,1.2
With shaped input noise level=65dB	0.4,1.2	0.4,1.2	0.4,1.2
Battery voltage (V)	1.33,1.31	1.34,1.31	1.33,1.31

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
TE496	-0.5	-0.5	-1	-1	0	4.5	7.5	9.5	13	16
TE497	-0.5	-0.5	-1	-1	1	5	8	10	13	16.5
TE498	-0.5	-0.5	-1	-1	0	4	7	9	12	15

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
TE496	20	23.5	25	24	21	19.5	22	21	10	4.5
TE497	20.5	24	24.5	22.5	19.5	17.5	20	18	4.5	1.5
TE498	19	22	24	23.5	20.5	17.5	19.5	19	9	5
							edb	edb	edb	


TELEX - 340 CLO (Wireless) CROS
TE496N
TE497N
TE498N
30
20
10
0
-10
-20
INSERTION GAIN (dB)
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

TELEX - 350 BC (Wireless) BICROS **BI**

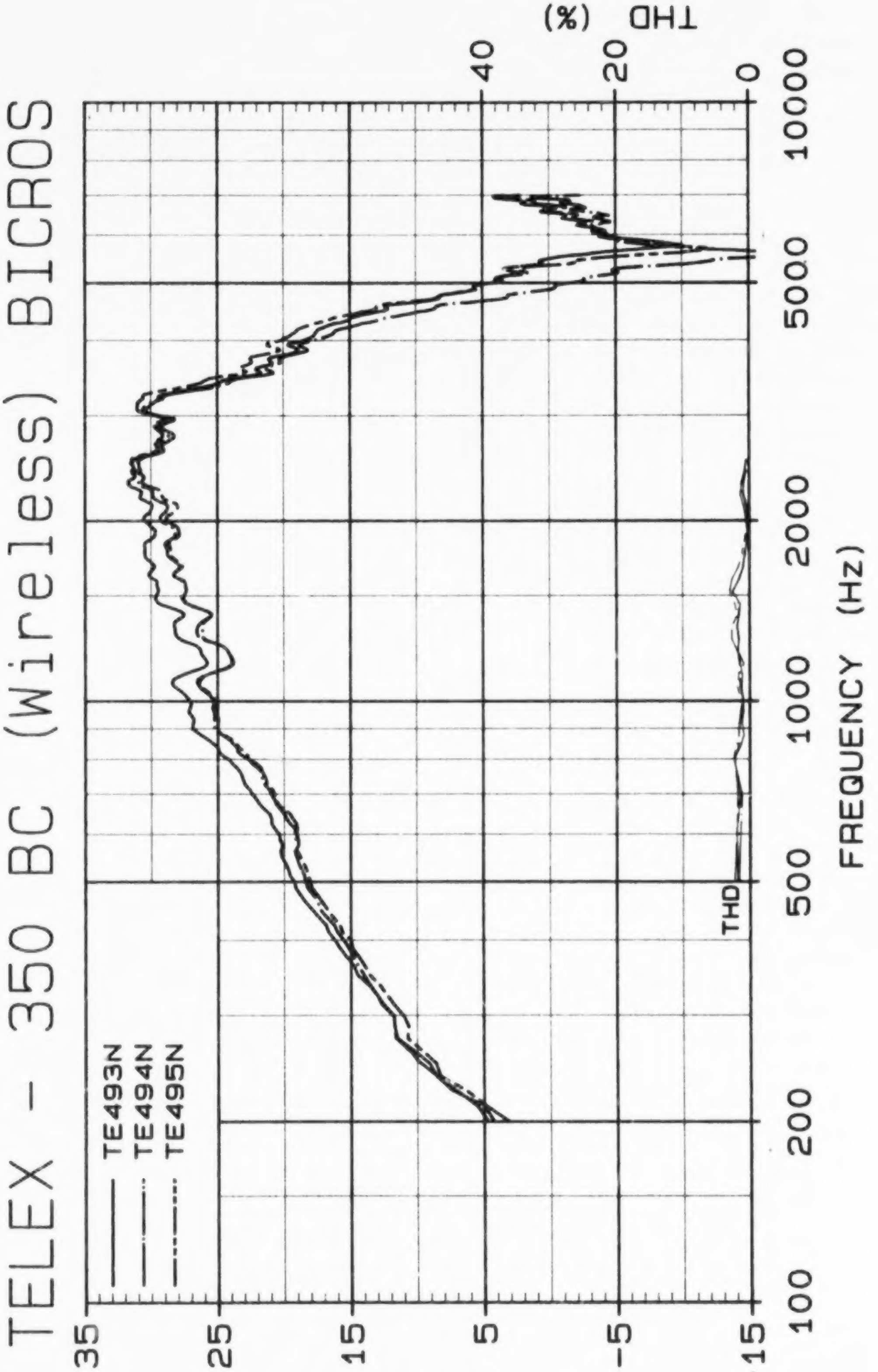
SETTINGS - Low Cut:0 SPL:115
BATTERY - 675

NBS CODE	TE493	TE494	TE495
SERIAL NO.	882325	882344	882346
DATE TESTED	6/21/88	6/20/88	6/20/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	51	52.5	52.5
SSPL for shaped noise signal (dB)	116.5	116.5	116
with input spl (dB)	60	58	56
Induction coil output level (dB)			
Self noise	65.5	66.5	72
Vertical field= 10 mA/m	101	102.5	106.5
Lateral field= 10 mA/m	73	85	90.5
Longitud field= 10 mA/m	89.5	87	98
Calculated maximum	101	102.5	107
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	27	25	24.5
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	2	2	2
800 Hz (%)	2	2	2
1600 Hz (%)	2	1	3
Maximum distortion above 800 Hz (%)	3	3	3
Freq. of max. (Hz)	1520	1520	1520
Equivalent input noise level (dB)	27.5	26.5	27.5
Battery drain (mA)			
No input signal	0.4,1.2	0.4,1.1	0.4,1.1
With shaped input noise level=65dB	0.4,1.2	0.4,1.1	0.4,1.1
Battery voltage (V)	1.33,1.31	1.32,1.31	1.32,1.31

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
TE493	9.5	15.5	19	21	23.5	26.5	27.5	27	28.5	30
TE494	9.5	15	18	19.5	22	25	25.5	25	26.5	28
TE495	9	14.5	18	19.5	22	25	25.5	25	26.5	27.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
TE493	30.5	30	30.5	31.5	29.5	29.5	25	19	10	-2
TE494	28.5	28.5	29.5	30.5	29.5	29.5	24	18	6	-8.5
TE495	28.5	28	28.5	30.5	30	30	26.5	20.5	10.5	-3.5
							edb	edb	edb	



TELEX - 350 BC (Wireless) BICROS

TELEX - 363C AI CO

SETTINGS - AGC:65 SPL:Max Tone:0
BATTERY - 675

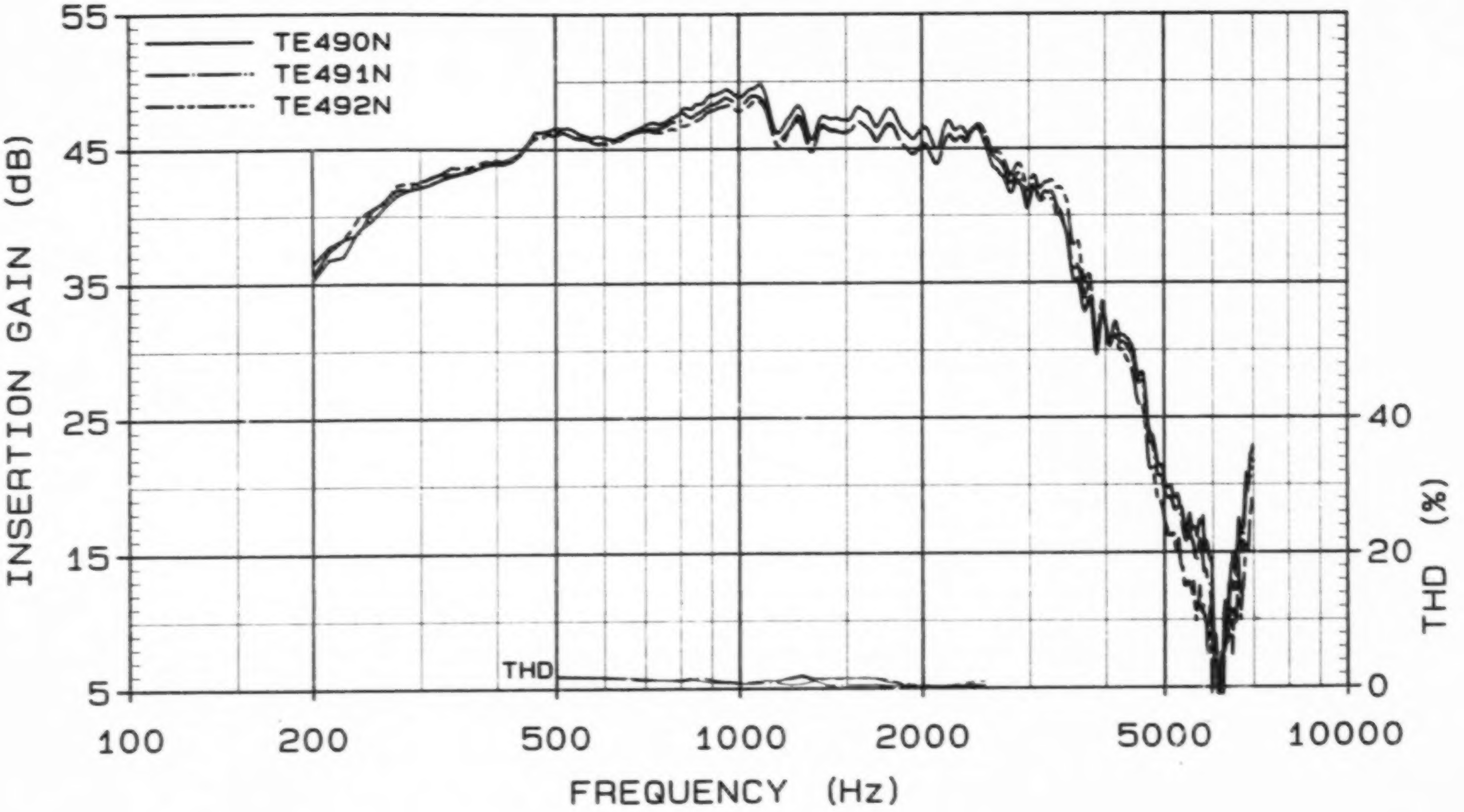
NBS CODE	TE490	TE491	TE492
SERIAL NO.	8813712A1	8813755A1	8813757A1
DATE TESTED	6/24/88	6/28/88	6/28/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	59	59.5	59
SSPL for shaped noise signal (dB)	130.5	131	131
with input spl (dB)	74	74	74
Induction coil output level (dB)			
Self noise	80.5	78	80.5
Vertical field- 10 mA/m	113.5	110	111.5
Lateral field- 10 mA/m	91	84	84
Longitud field- 10 mA/m	95.5	97.5	97
Calculated maximum	113.5	110.5	111.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	48.5	47.5	47
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	2	2	2
800 Hz (%)	1	1	1
1600 Hz (%)	1	0	2
Maximum distortion above 800 Hz (%)	2	2	2
Freq. of max. (Hz)	1270	830	1270
Equivalent input noise level (dB)	23	22.5	23
Battery drain (mA)			
No input signal	1.6	1.6	2.0
With shaped input noise level=65dB	8.0	4.8	7.0
Battery voltage (V)	1.31	1.32	1.31

Average insertion gain (dB) in 20 bands (center frequencies shown)

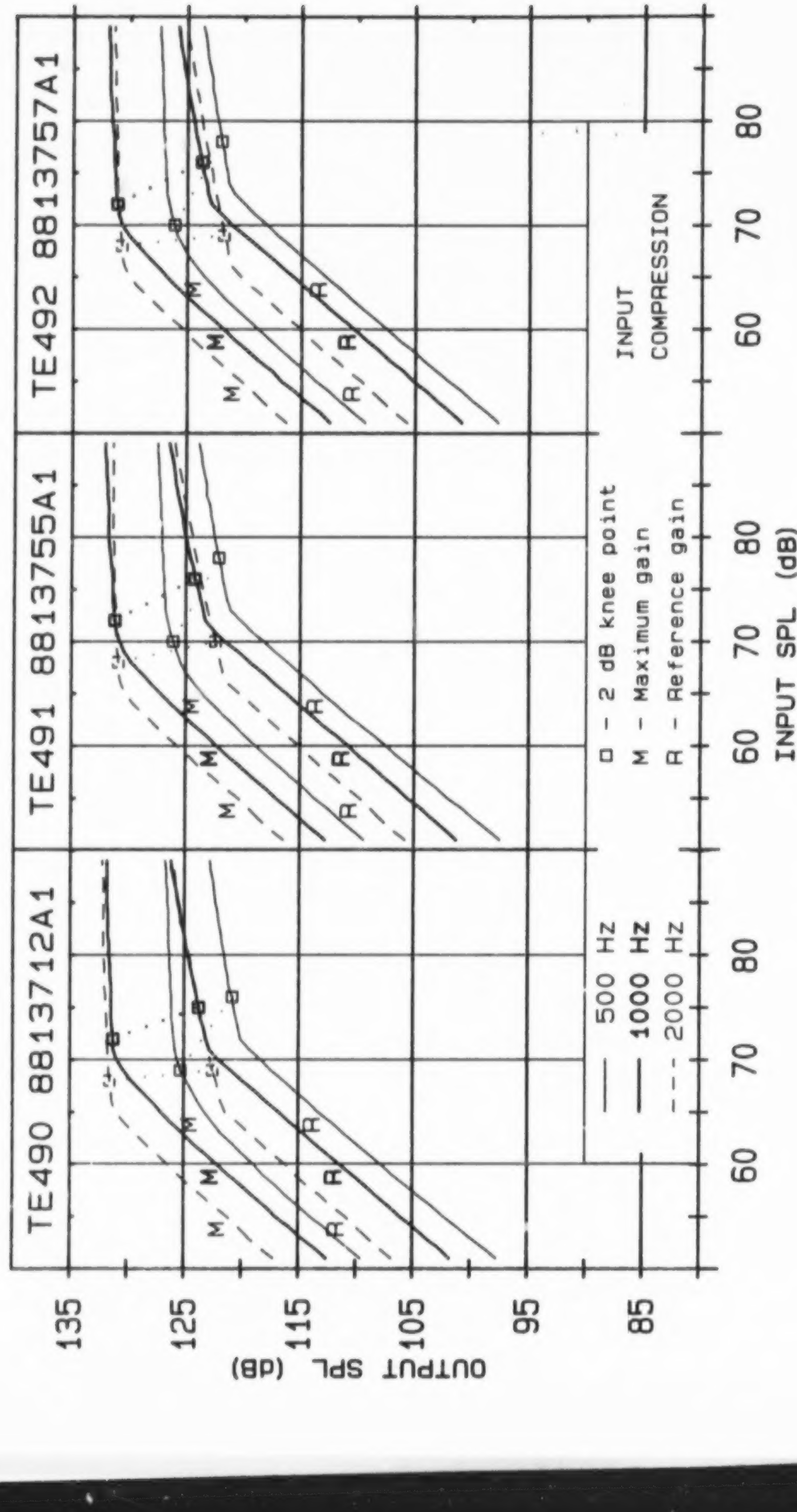
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
TE490	40	43.5	46	46	47.5	49	49	47	47	47.5
TE491	40.5	43.5	46	46	47	48.5	48	46.5	46	46.5
TE492	40.5	44	46	46	46.5	48	48	45	46	46.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
TE490	47.5	46	46	46.5	43.5	41.5	39	32	26	17.5
TE491	46	45	45	46	44.5	42	39	32.5	25.5	16
TE492	46.5	45	45	46	45	43	40.5	32.5	24	12.5
							edb	edb	edb	

TELEX - 363C AI



TELEX - 363C AI



OUTPUT SPL VS. INPUT SPL

TELEX - 402 BICROS (Wireless) BI

SETTINGS - N
BATTERY - 675

NBS CODE	TE502	TE503	TE504
SERIAL NO.	884077	884079	884084
DATE TESTED	6/21/88	6/21/88	6/21/88

DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING

Gain at 1kHz (dB)	65	64.5	64.5
SSPL for shaped noise signal (dB)	130.5	130.5	130
with input spl (dB)	58	60	58
Induction coil output level (dB)			
Self noise	84.5	75.5	76
Vertical field= 10 mA/m	112.5	111	111.5
Lateral field= 10 mA/m	110.5	112	112
Longitud field= 10 mA/m	120.5	119.5	119.5
Calculated maximum	121.5	120.5	121

DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING

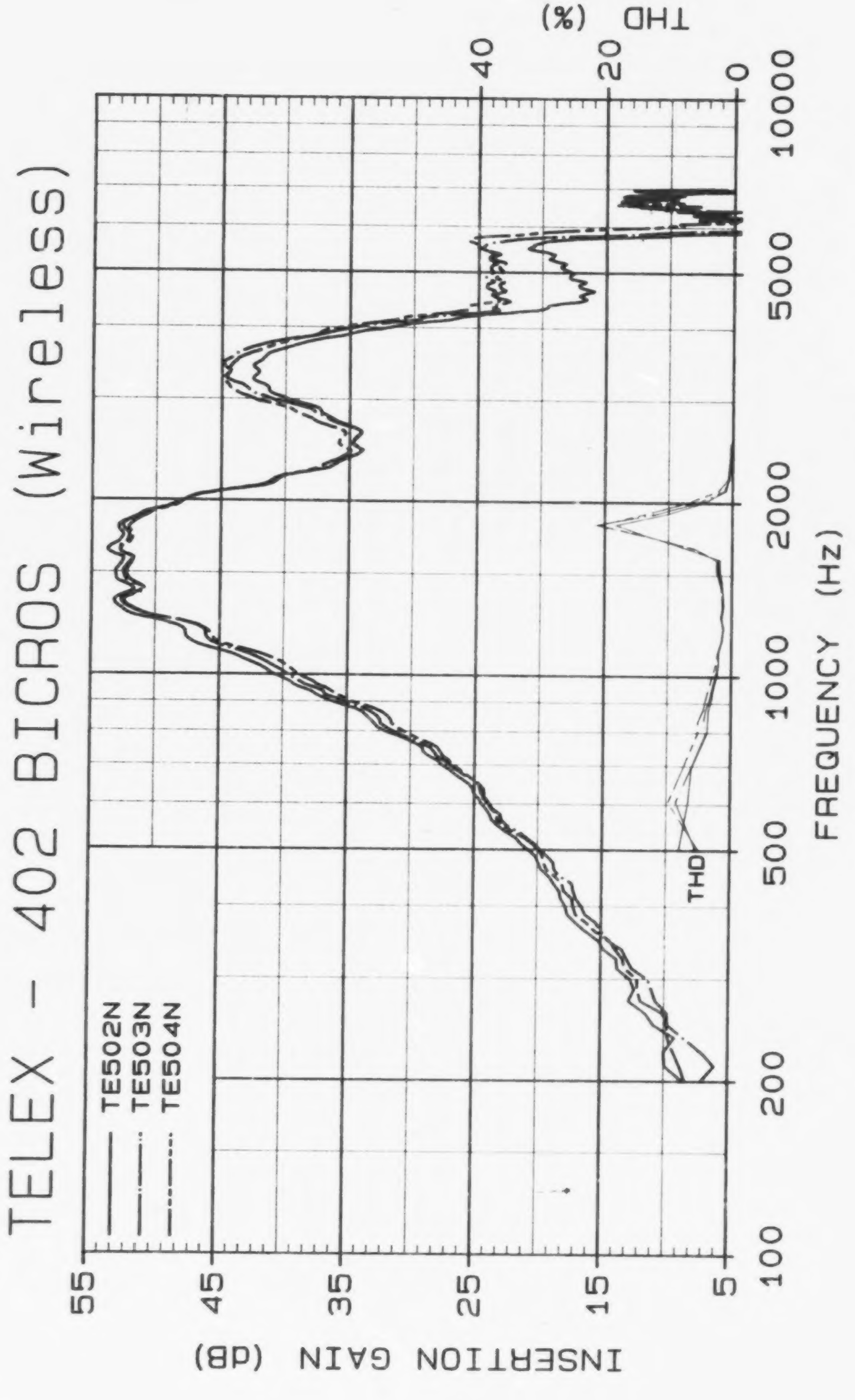
Gain at 1kHz (dB)	40.5	39.5	38.5
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	8	6	5
800 Hz (%)	4	4	5
1600 Hz (%)	2	2	2
Maximum distortion above 800 Hz (%)	18	21	21
Freq. of max. (Hz)	1830	1830	1830
Equivalent input noise level (dB)	21	20	19.5
Battery drain (mA)			
No input signal	1.7,.6	1.7,.7	1.7,.7
With shaped input noise level=65dB	1.7,.6	1.7,.7	1.7,.7
Battery voltage (V)	1.31,1.32	1.30,1.32	1.30,1.32

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
TE502	11.5	17	20.5	25	30.5	37	43.5	49.5	52.5	53
TE503	9.5	15.5	19.5	24.5	30	36	42.5	48	52	52
TE504	11	16	20	24.5	29	35	41.5	48	52	52.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
TE502	53	50	42.5	35.5	35	39.5	42	33	18	15.5
TE503	52.5	50	42.5	35.5	35	41	44.5	35.5	24	20
TE504	52	49.5	42.5	36	36.5	42	44	36	24	23

edb edb edb



TELEX - 402 BICROS (Wireless)
TE502N
TE503N
TE504N
THD
INSERTION GAIN (dB)
55
45
35
25
15
5
THD (%)
40
20
0
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

TELEX - 402 CROS (Wireless) CR

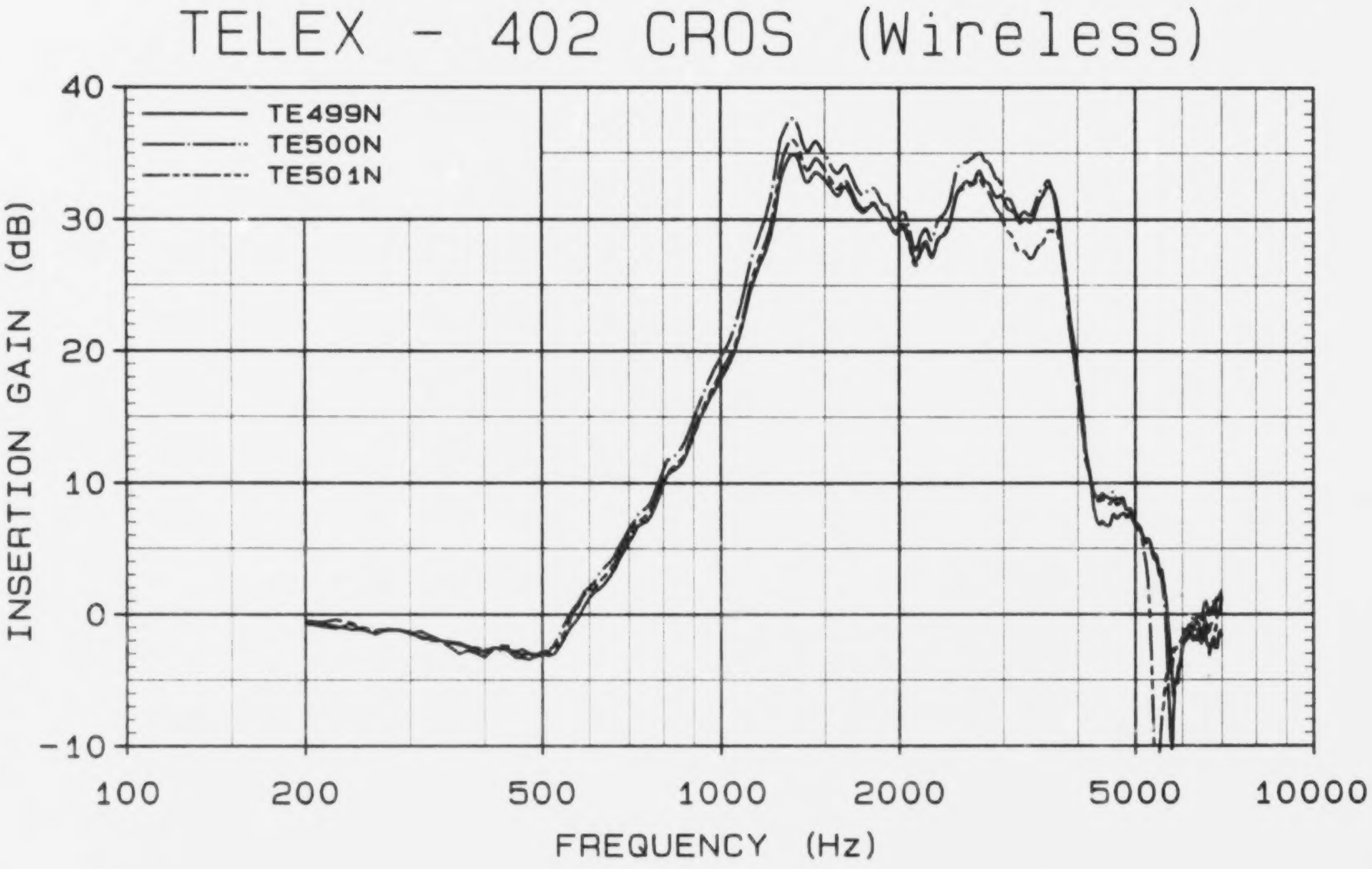
SETTINGS - Normal
BATTERY - 675

NBS CODE	TE499	TE500	TE501
SERIAL NO.	884487	884510	884522
DATE TESTED	6/20/88	6/20/88	6/20/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	22.5	28	26.5
SSPL for shaped noise signal (dB)	118	118	118
with input spl (dB)	76	72	72
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	17.5	19.5	18.5
Equivalent input noise level (dB)	20	19.5	19
Battery drain (mA)			
No input signal	0.6,.6	0.6,.6	0.6,.6
With shaped input noise level=65dB	0.6,.6	0.6,.6	0.6,.6
Battery voltage (V)	1.34,1.34	1.31,1.32	1.31,1.31

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
TE499	-1	-2.5	-3	2	8.5	14.5	21	30	34	32.5
TE500	-1	-2.5	-2.5	3	9.5	16	23	33	36	34
TE501	-1	-2.5	-2.5	2.5	8.5	15	21.5	31	35	33

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
TE499	31	30	28	29	33	31.5	31	20.5	7.5	1.5
TE500	32.5	31	29	30.5	34.5	32	31.5	19.5	8.5	0.5
TE501	31.5	30	28	29	32.5	30	28	19.5	8.5	-3
							edb	edb	edb	


TELEX - 402 CROS (Wireless)
TE499N
TE500N
TE501N
INSERTION GAIN (dB)
40
30
20
10
0
-10
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

UNITRON - UE10 CO

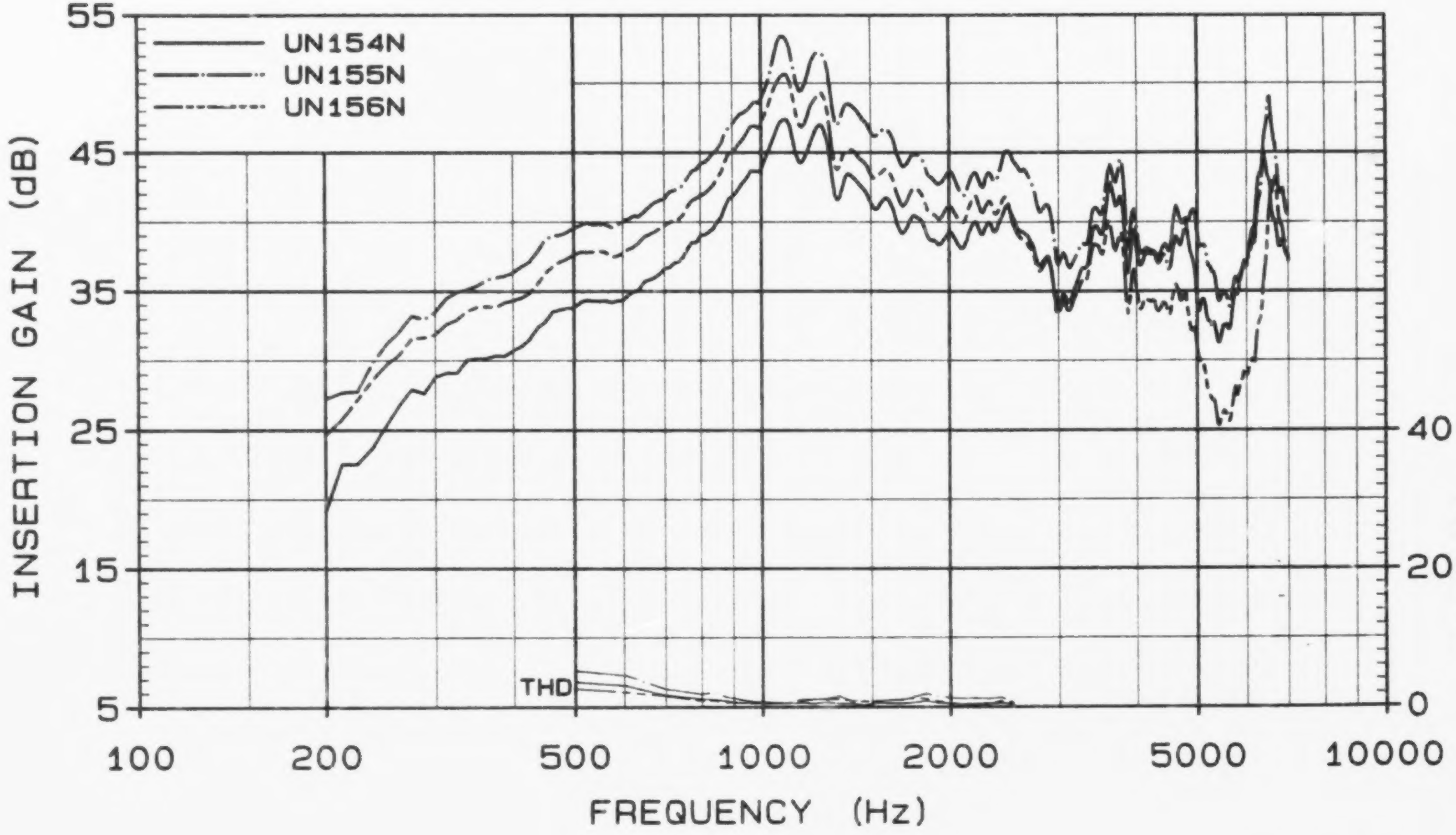
SETTINGS - MPO:136 Compression:55 Tone:N
BATTERY - 675

NBS CODE	UN154	UN155	UN156
SERIAL NO.	A285	Z792	CA80
DATE TESTED	5/11/88	5/11/88	5/11/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	61	63	61.5
SSPL for shaped noise signal (dB)	126.5	130	127
with input spl (dB)	72	70	70
Induction coil output level (dB)			
Self noise	89	88.5	87.5
Vertical field- 10 mA/m	108.5	110	119.5
Lateral field- 10 mA/m	90.5	89	102.5
Longitud field- 10 mA/m	99.5	101.5	113
Calculated maximum	109	110.5	120.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	47	50	48.5
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	4	5	3
800 Hz (%)	1	2	1
1600 Hz (%)	1	1	1
Maximum distortion above 800 Hz (%)	1	2	1
Freq. of max. (Hz)	830	830	1750
Equivalent input noise level (dB)	30	27.5	28
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.34	1.34	1.34

Average insertion gain (dB) in 20 bands (center frequencies shown)

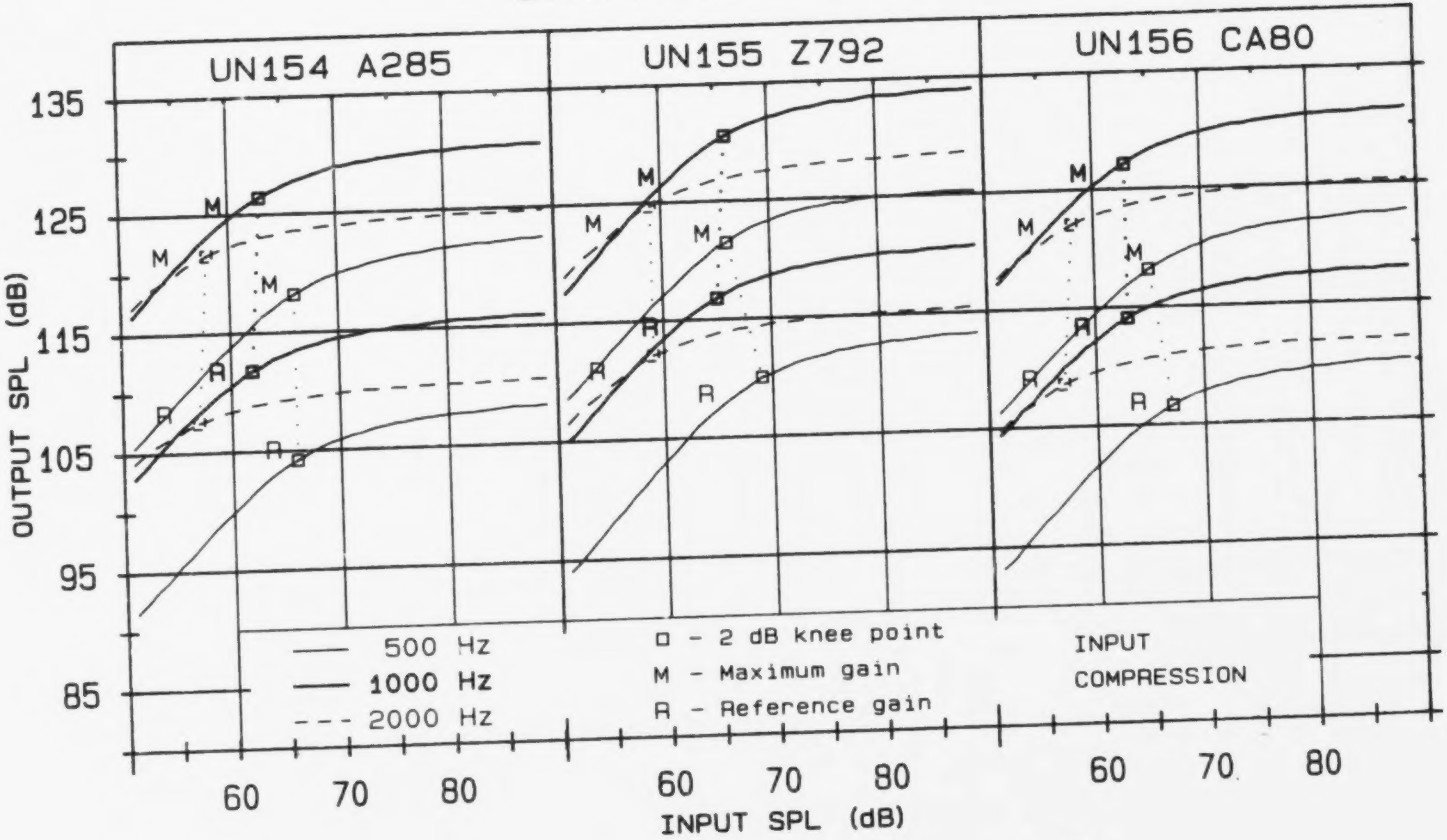
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
UN154	25.5	30.5	33.5	35	38	42.5	46	45.5	42.5	41
UN155	31.5	36	39.5	40.5	43.5	47.5	51.5	51	48	46
UN156	29.5	34	37	38.5	41	45.5	49	48	44.5	43.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
UN154	40	39	39	40	39	35.5	39	39	38.5	33.5
UN155	44.5	43	43	43.5	43	38.5	40.5	40	38.5	36
UN156	42	40.5	41	41	38.5	35	37.5	35.5	33.5	27.5
								ts	ts	ts



UNITRON - UE10

UNITRON - UE10



OUTPUT SPL VS. INPUT SPL

UNITRON - UE10-H **HP**

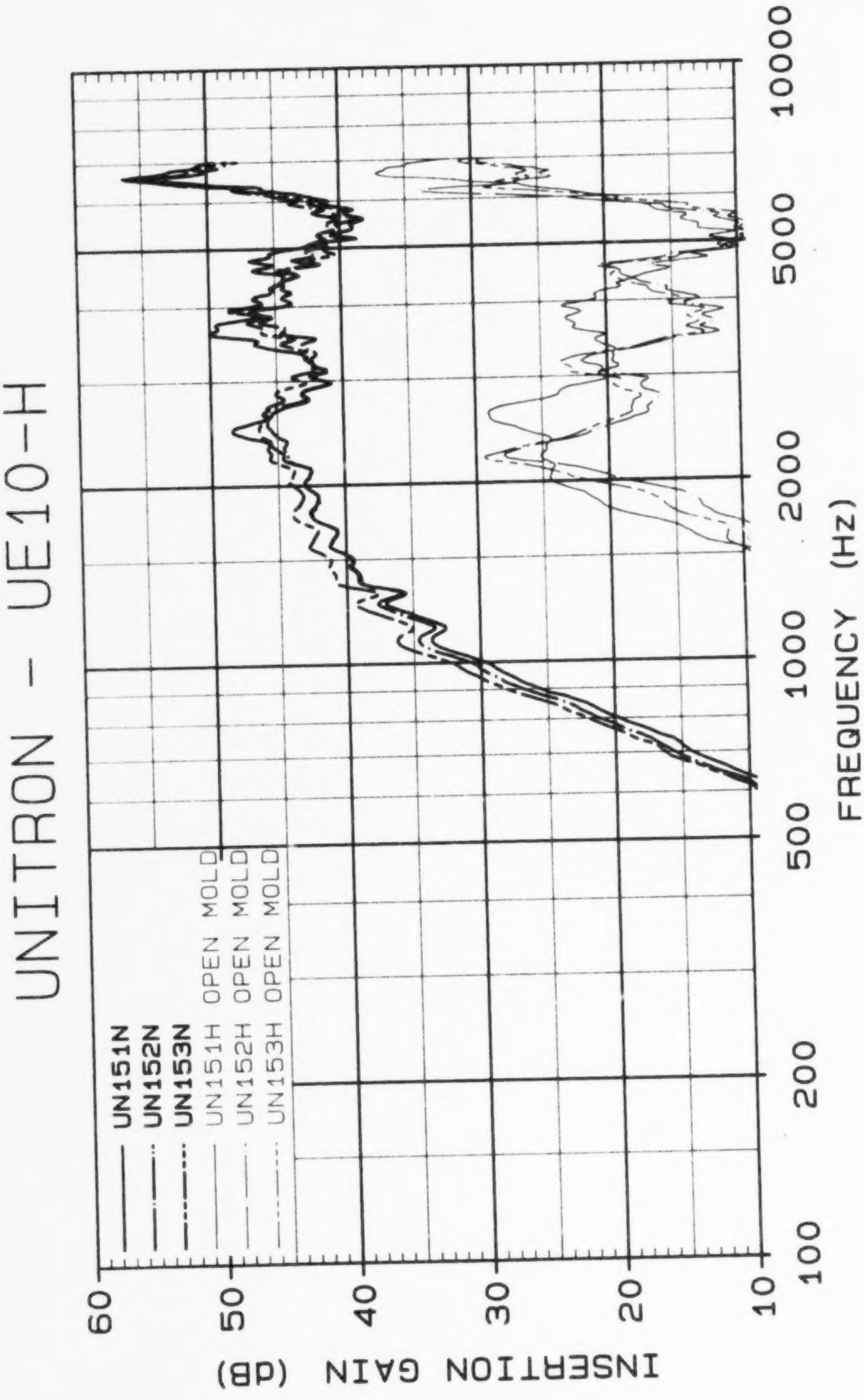
SETTINGS - MPO:131 Compression:85 Tone:H
BATTERY - 675

NBS CODE	UN151	UN152	UN153
SERIAL NO.	T673	S265	R022
DATE TESTED	4/19/88	4/19/88	4/20/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	39.5	35	42
SSPL for shaped noise signal (dB)	131	130.5	131
with input spl (dB)	70	74	70
Induction coil output level (dB)			
Self noise	81.5	83	84
Vertical field= 10 mA/m	111.5	97	98
Lateral field= 10 mA/m	92	85	87
Longitud field= 10 mA/m	104	91	93.5
Calculated maximum	112	98.5	100
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	29.5	31	32
Equivalent input noise level (dB)	25.5	29	25.5
Battery drain (mA)			
No input signal	1.1	1.0	0.9
With shaped input noise level=65dB	1.1	2.1	2.1
Battery voltage (V)	1.32	1.32	1.32

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
UN151	-12	-5.5	2	9.5	18	26	32.5	35.5	38.5	40.5
UN152	-8.5	-7	-0.5	10.5	19.5	27.5	33.5	36	38.5	40.5
UN153	-7	-3	2.5	11.5	20	29	35	37.5	40.5	42

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
UN151	42	42.5	43.5	46.5	45	42	45.5	46	45	40
UN152	42	42.5	43	44.5	45	42	43	46	43.5	41.5
UN153	43.5	43.5	44.5	46	45.5	43.5	44	46.5	43	40.5
							edb	edb	edb	


UNITRON - UE10-H
UN151N
UN152N
UN153N
UN151H OPEN MOLD
UN152H OPEN MOLD
UN153H OPEN MOLD
INSERTION GAIN (dB)
60
50
40
30
20
10
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

UNITRON - UM60-H **HP**

SETTINGS - MPO:117 Tone:H
BATTERY - 13

NBS CODE	UN148	UN149	UN150
SERIAL NO.	M873	M599	M646
DATE TESTED	4/14/88	4/14/88	4/14/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	32.5	32	33
SSPL for shaped noise signal (dB)	116	115.5	115
with input spl (dB)	74	80	80
Induction coil output level (dB)			
Self noise	82.5	79	76.5
Vertical field= 10 mA/m	109	109	106
Lateral field= 10 mA/m	97.5	95	93
Longitud field= 10 mA/m	106	105	105
Calculated maximum	111	110.5	108.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	20.5	20	21
Equivalent input noise level (dB)	24	24	24
Battery drain (mA)			
No input signal	1.2	1.3	N.M.
With shaped input noise level=65dB	1.2	1.3	N.M.
Battery voltage (V)	1.33	1.32	N.M.

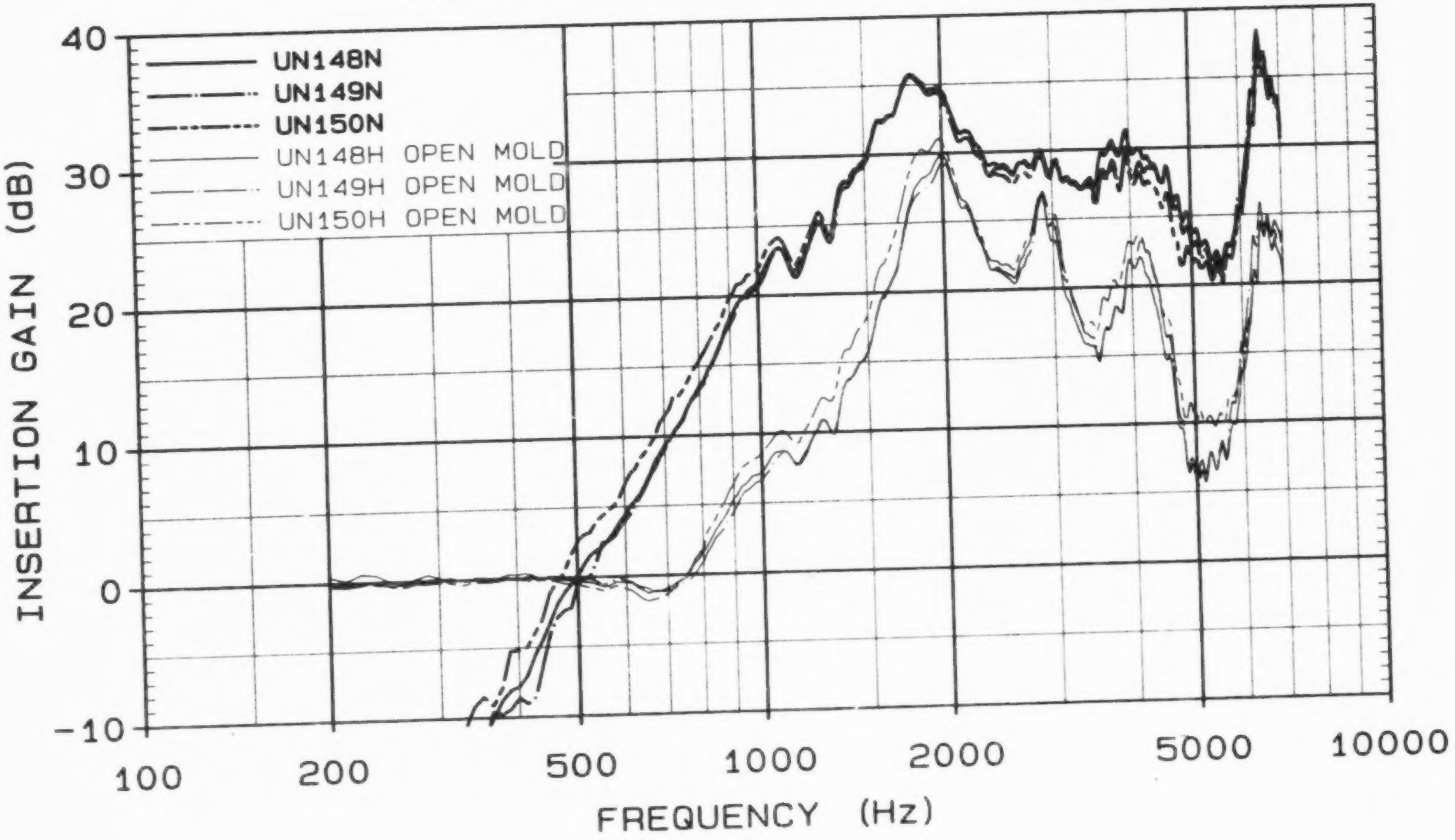
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
UN148	-18	-9	-0.5	5.5	12	19	22.5	24	27.5	31.5
UN149	-20.5	-10	-1.5	5.5	12	18.5	22.5	23.5	27	31.5
UN150	-17.5	-7	1.5	7.5	14	20	23.5	24.5	27.5	31.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
UN148	34.5	34.5	32	29.5	29	29	28	30	27	23
UN149	34.5	34.5	31.5	29	29	29	27.5	28.5	26.5	22.5
UN150	34.5	35	32	29	28	28.5	27	28	24.5	22

edb edb edb

UNITRON - UM60-H



VIENNATONE - 117 ASP

SETTINGS - PC:0 G:0 CTB:N
BATTERY - 675

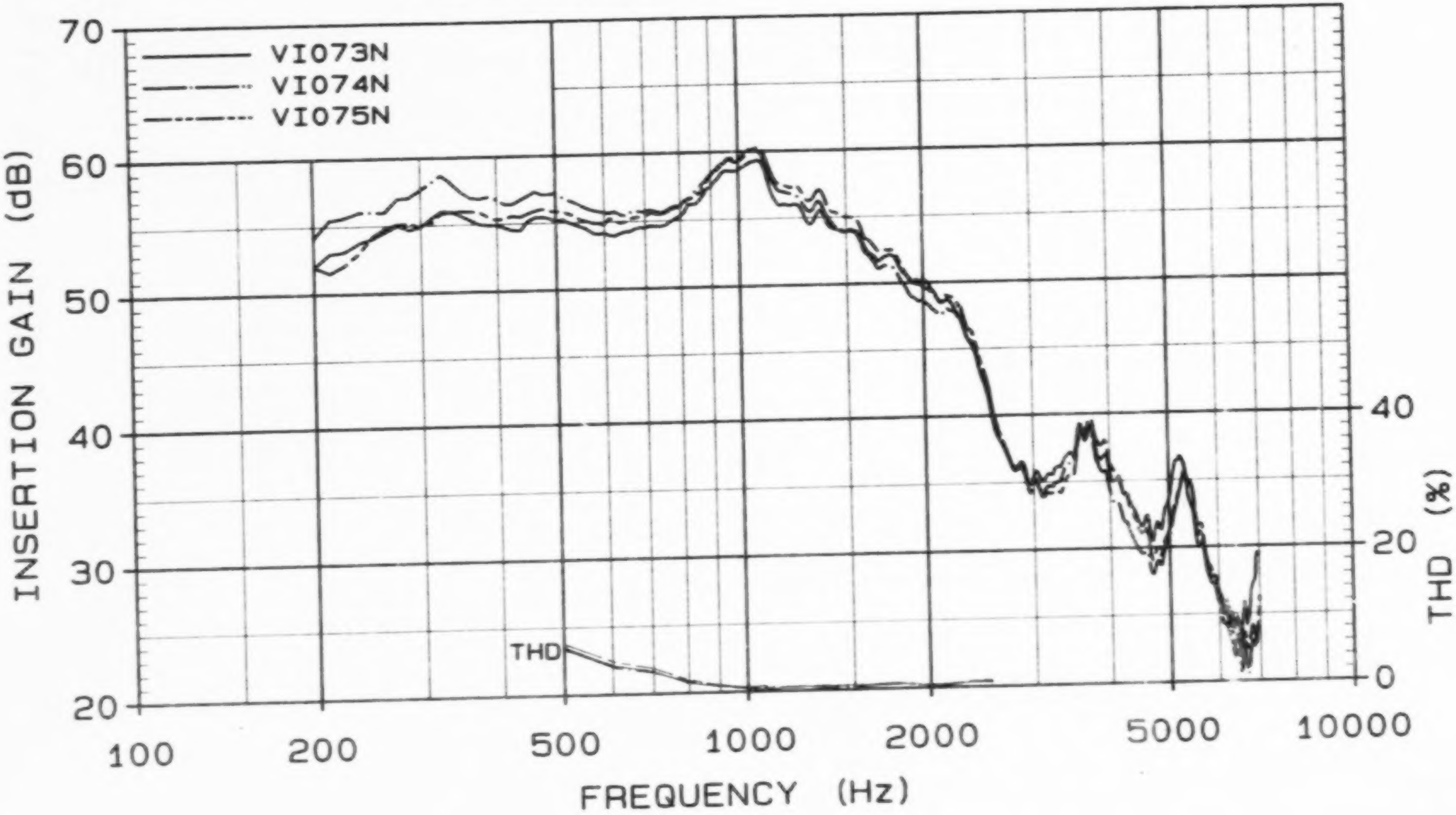
NBS CODE	VI073	VI074	VI075
SERIAL NO.	03652	03461	03683
DATE TESTED	6/27/88	6/27/88	6/27/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	75.5	75	74
SSPL for shaped noise signal (dB)	135.5	136	136
with input spl (dB)	64	66	66
Induction coil output level (dB)			
Self noise	91	88	85
Vertical field= 10 mA/m	116	108.5	106.5
Lateral field= 10 mA/m	92.5	101.5	91
Longitud field= 10 mA/m	115.5	113	110
Calculated maximum	118.5	114.5	112
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	58.5	59	59
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	7	7	7
800 Hz (%)	1	2	2
1600 Hz (%)	1	0	1
Maximum distortion above 800 Hz (%)	1	1	2
Freq. of max. (Hz)	830	830	830
Equivalent input noise level (dB)	19	20	18.5
Battery drain (mA)			
No input signal	1.3	1.4	1.3
With shaped input noise level=65dB	4.0	4.9	3.7
Battery voltage (V)	1.31	1.30	1.30

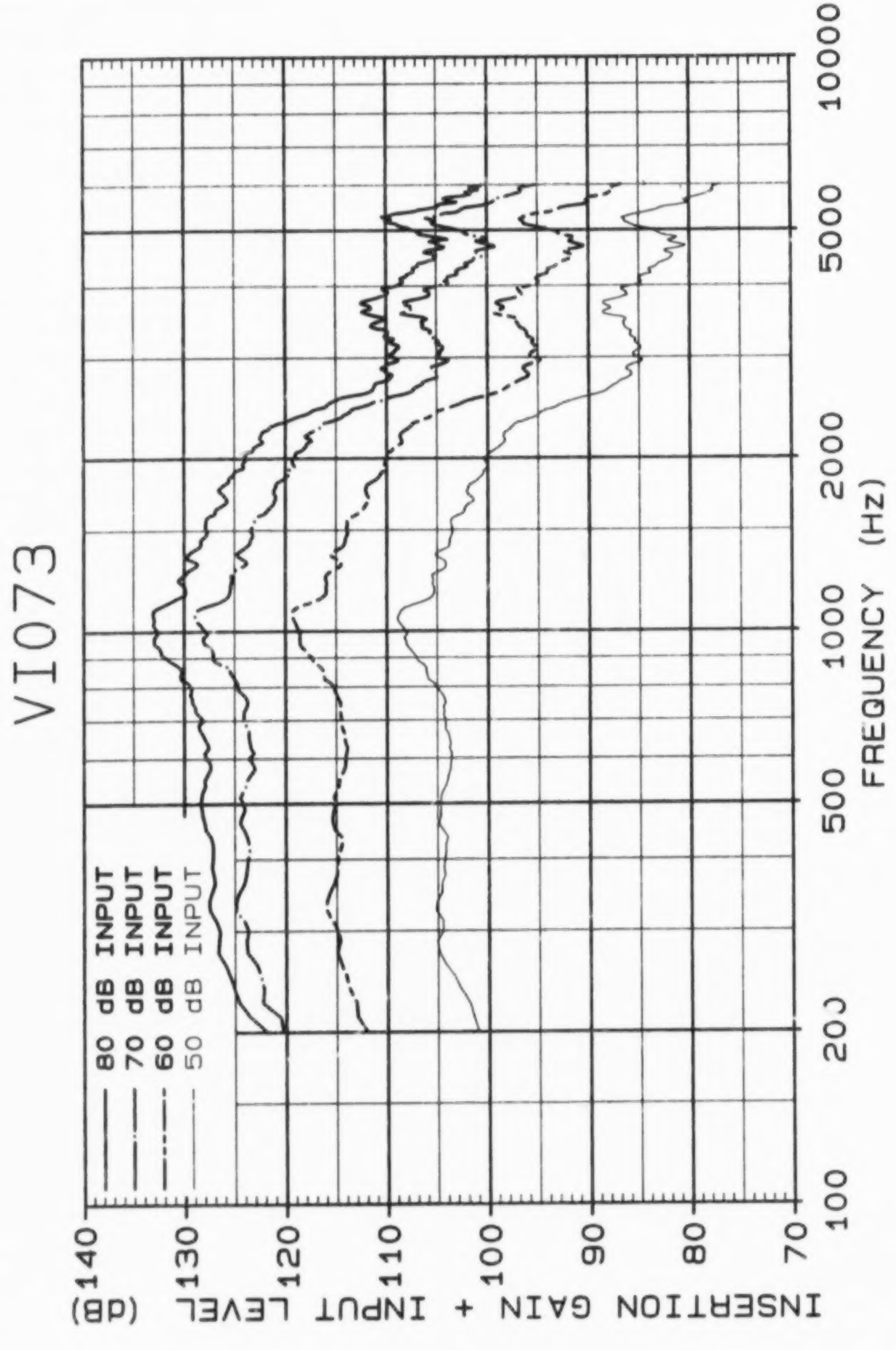
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
VI073	54	55	55	54	55	57.5	58.5	55.5	54.5	53.5
VI074	56.5	57	57	55.5	56	58.5	59.5	56.5	55	53
VI075	54	55.5	55.5	55	56	58.5	59.5	57	56	54

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
VI073	52	50.5	49	45.5	38.5	35.5	37	36.5	32.5	32
VI074	51	49	48	46	39	35	36.5	35.5	30	31.5
VI075	52.5	50	49	46.5	39	35	35.5	37	31	32
							edb	edb	edb	

VIENNATONE - 117




VI073
INSERTION GAIN + INPUT LEVEL (dB)
140
130
120
110
100
90
80
70
FREQUENCY (Hz)
100
200
500
1000
2000
5000
10000
80 dB INPUT
70 dB INPUT
60 dB INPUT
50 dB INPUT

ASP

VIENNATONE - 119

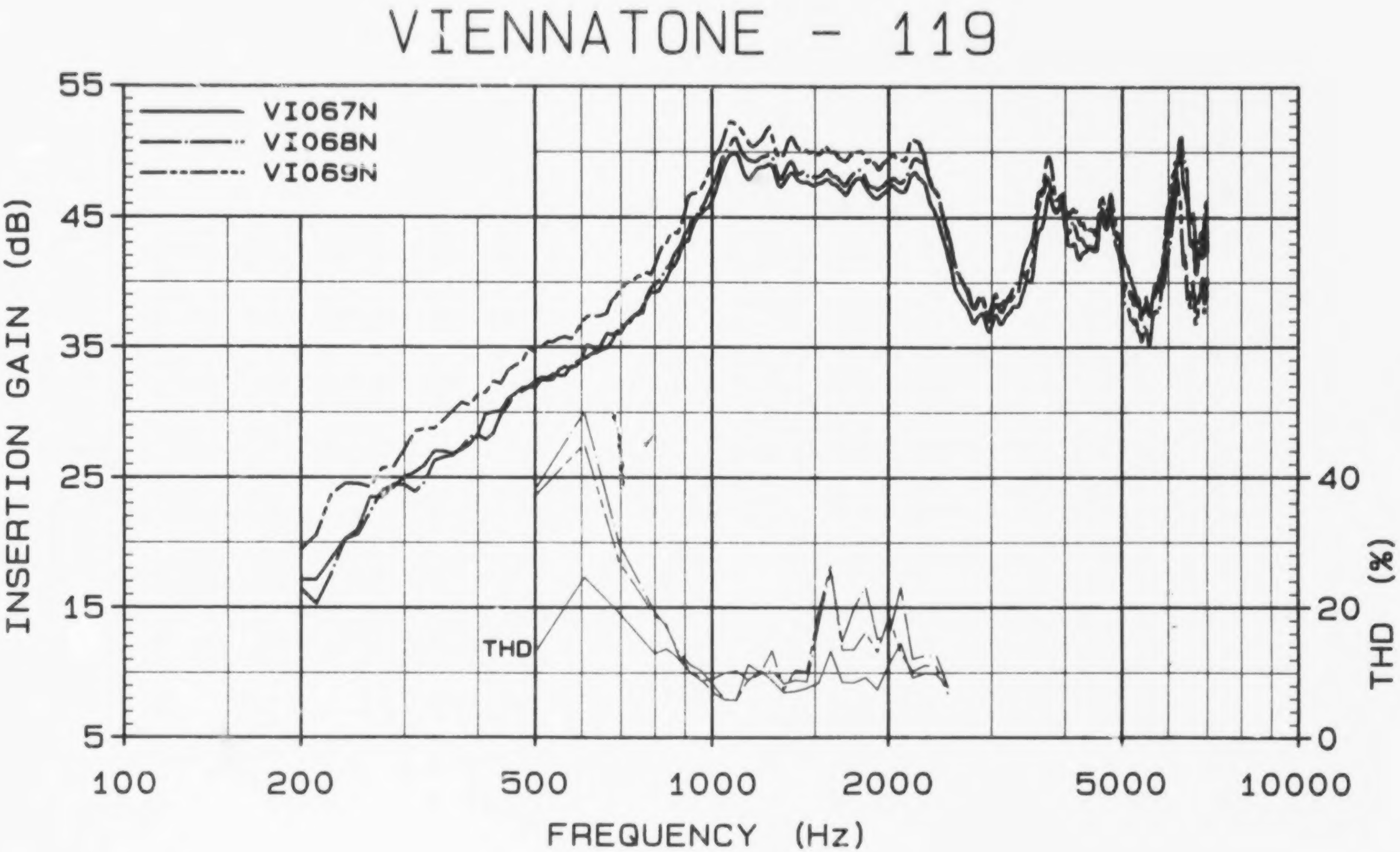
SETTINGS - G:0 GL:0 GH:0 PC:0
BATTERY - 675

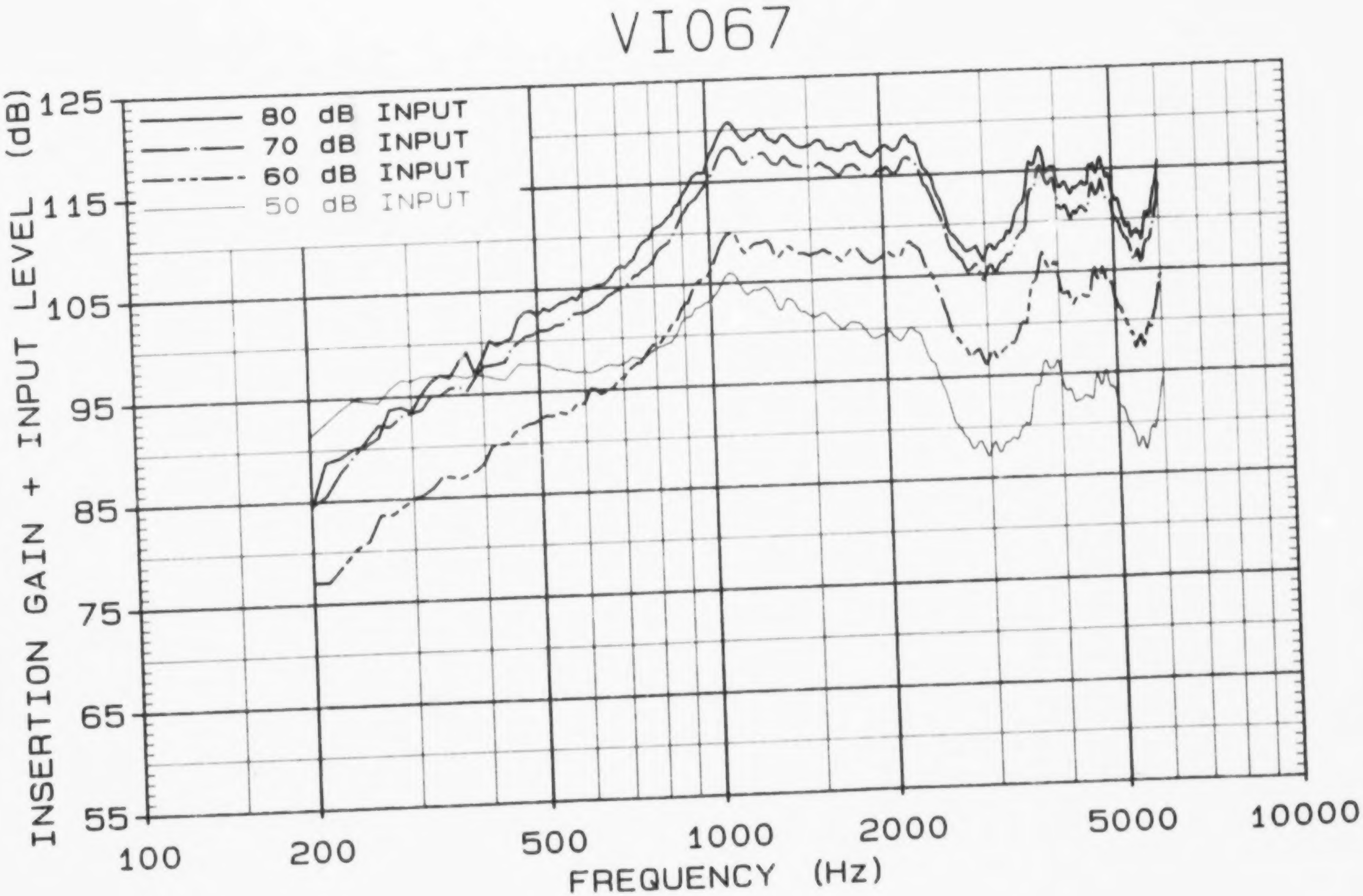
NBS CODE	VI067	VI068	VI069
SERIAL NO.	00183	00230	00247
DATE TESTED	6/24/88	6/24/88	6/24/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	57	58.5	59
SSPL for shaped noise signal (dB)	130.5	131.5	132
with input spl (dB)	72	68	70
Induction coil output level (dB)			
Self noise	78	76.5	77
Vertical field- 10 mA/m	110	111	110.5
Lateral field- 10 mA/m	88	91.5	92
Longitud field- 10 mA/m	107	108.5	108
Calculated maximum	112	113	112.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	49.5	48	49.5
Harmonic distortion with input spl-70 (dB)			
500 Hz (%)	14	39	38
800 Hz (%)	13	19	19
1600 Hz (%)	13	26	26
Maximum distortion above 800 Hz (%)	15	26	26
Freq. of max. (Hz)	2100	1590	1590
Equivalent input noise level (dB)	26	23	22
Battery drain (mA)			
No input signal	1.2	1.2	1.2
With shaped input noise level-65dB	1.8	1.9	2.0
Battery voltage (V)	1.32	1.31	1.31

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
VI067	22	28	32	34.5	38.5	43.5	48.5	48.5	48	47.5
VI068	21.5	27.5	32	34.5	38.5	44.5	49.5	49.5	48.5	48
VI069	25	30.5	34.5	37	41	46	51	51	50.5	50

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
VI067	47.5	47	47.5	46	39	37	40	44.5	43.5	40
VI068	48	47.5	48.5	47.5	40.5	38	42.5	45.5	43.5	37.5
VI069	49.5	49	50	48	40.5	38.5	41.5	46.5	44.5	39.5
							edb	edb	edb	


VIENNATONE - 119
VI067N
VI068N
VI069N
INSERTION GAIN (dB)
55
45
35
25
15
5
THD (%)
40
20
0
THD
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)


VI067
80 dB INPUT
70 dB INPUT
60 dB INPUT
50 dB INPUT
INSERTION GAIN + INPUT LEVEL (dB)
125
115
105
95
85
75
65
55
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

VIENNATONE - 132 **HP**

SETTINGS - AGC:O Tone:H
BATTERY - 312

NBS CODE	VI070	VI071	VI072
SERIAL NO.	00151	00709	00734
DATE TESTED	6/16/88	6/16/88	6/16/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	16.5	16.5	16
SSPL for shaped noise signal (dB)	95	94	94.5
with input spl (dB)	60	60	60
Induction coil output level (dB)			
Self noise	67.5	67.5	67.5
Vertical field- 10 mA/m	77.5	68.5	76
Lateral field- 10 mA/m	67.5	68	70
Longitud field- 10 mA/m	75.5	68.5	75.5
Calculated maximum	80.5	73	79.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	-9	-10	-9.5
Equivalent input noise level (dB)	29	29.5	28
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	N.M.	N.M.	N.M.

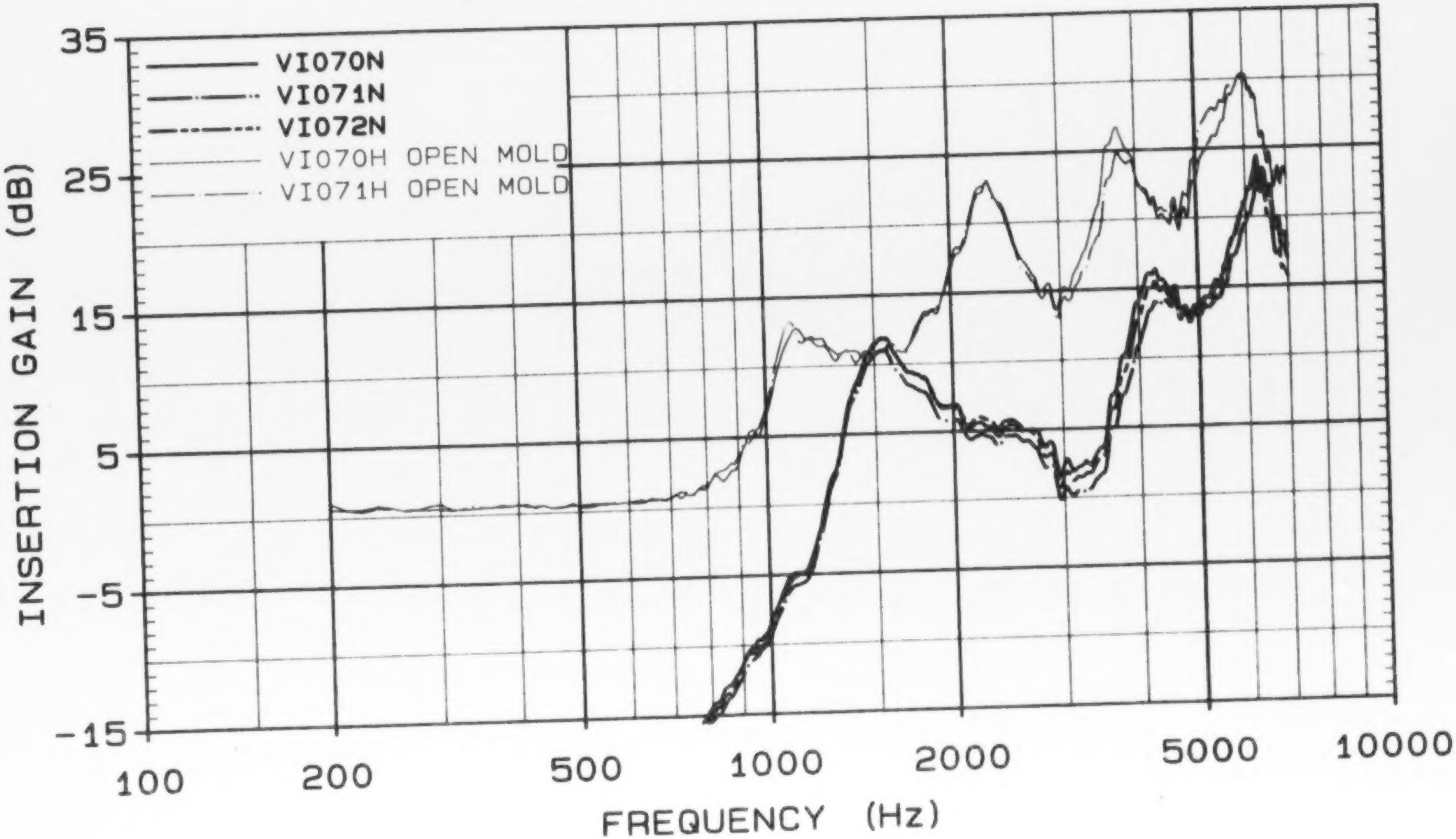
Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
VI070	-30	-24.5	-21.5	-19	-15.5	-11	-6	-0.5	8	11.5
VI071	-32.5	-26	-22.5	-20	-16.5	-11.5	-7	-1.5	7.5	10.5
VI072	-32.5	-24.5	-22.5	-19.5	-16	-11	-6.5	-1	8	11.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
VI070	9	7	5.5	5	5	2.5	4	13	14	16
VI071	8	6	5	4.5	3.5	1	2	10	13.5	17
VI072	9	7	6	5.5	4.5	2	3.5	11.5	14	17

edb edb edb

VIENNATONE - 132



WIDEX - F8+T **HP**

SETTINGS - Bass Cut:H COMP:0
BATTERY - 675

NBS CODE	WI211	WI212	WI213
SERIAL NO.	369372	369398	369548
DATE TESTED	5/3/88	5/4/88	5/4/88

DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING

	WI211	WI212	WI213
Gain at 1kHz (dB)	26	27	27.5
SSPL for shaped noise signal (dB)	124	125	125
with input spl (dB)	78	78	78
Induction coil output level (dB)			
Self noise	66.5	66.5	67
Vertical field= 10 mA/m	94.5	93.5	93
Lateral field= 10 mA/m	69.5	72	78.5
Longitud field= 10 mA/m	81	92.5	91
Calculated maximum	94.5	96	95

DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING

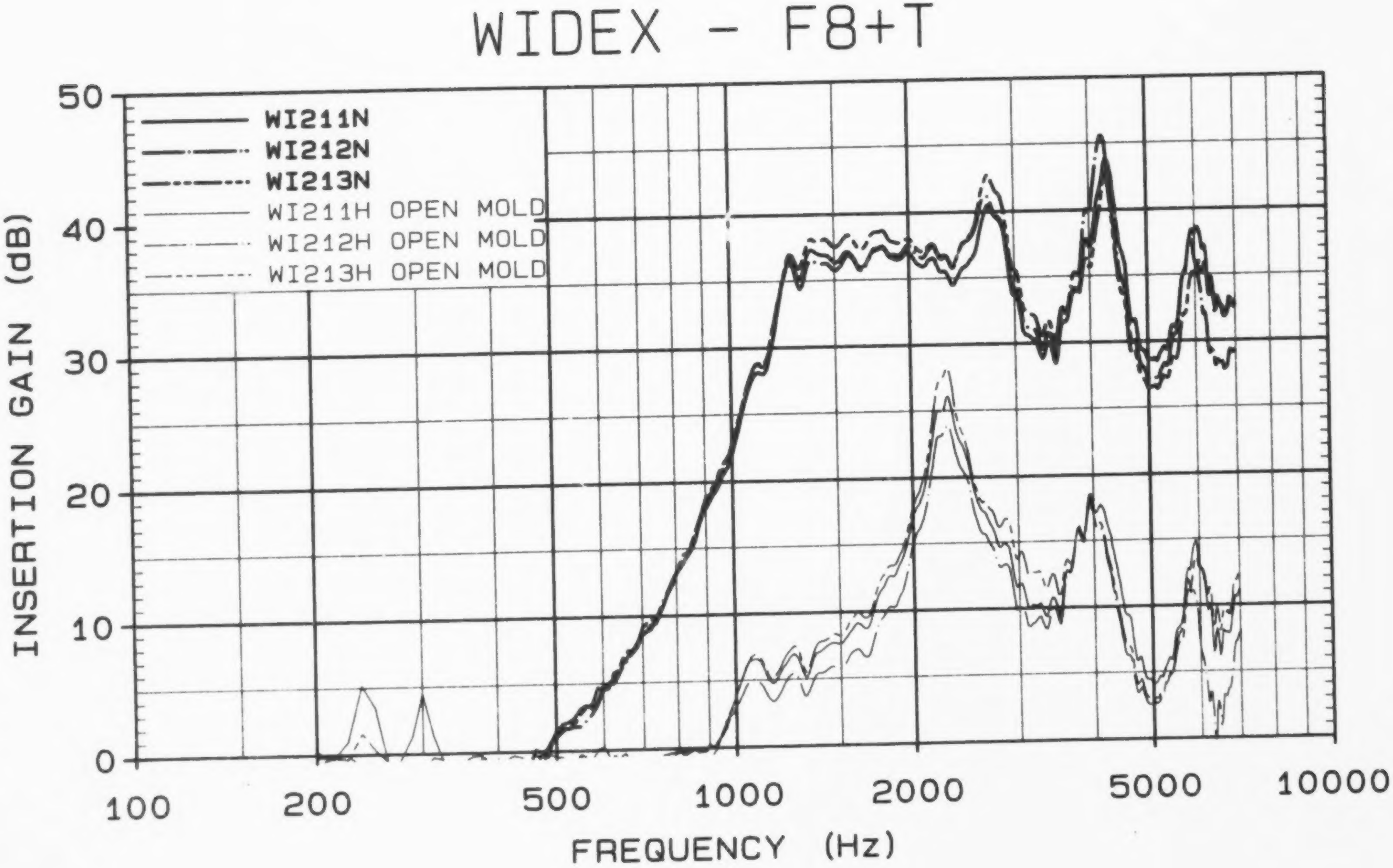
	WI211	WI212	WI213
Gain at 1kHz (dB)	22	22.5	22.5
Equivalent input noise level (dB)	19.5	18	17.5
Battery drain (mA)			
No input signal	1.7	N.M.	2.5
With shaped input noise level=65dB	1.7	N.M.	2.5
Battery voltage (V)	1.33	N.M.	1.33

Average insertion gain (dB) in 20 bands (center frequencies shown)

Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
WI211	-15	-6.5	1	5.5	11.5	18.5	26	33.5	36.5	36.5
WI212	-14.5	-6	0.5	5	11.5	19	26.5	33.5	36	36.5
WI213	-14	-6	0.5	5.5	11.5	19	26.5	34	37.5	38

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
WI211	37	36.5	36	35.5	38.5	34	30	37	35	32
WI212	37	37	37	36.5	39.5	34.5	30.5	39	33.5	31.5
WI213	38	38	37.5	37	40.5	36	31.5	36	32.5	29.5

ts ts ts


WIDEX - F8+T
WI211N
WI212N
WI213N
WI211H OPEN MOLD
WI212H OPEN MOLD
WI213H OPEN MOLD
INSERTION GAIN (dB)
0
10
20
30
40
50
FREQUENCY (Hz)
100
200
500
1000
2000
5000
10000

WIDEX - G6T **CO**

SETTINGS - Outp:0 Bass:N Comp:30 High:N
BATTERY - 675

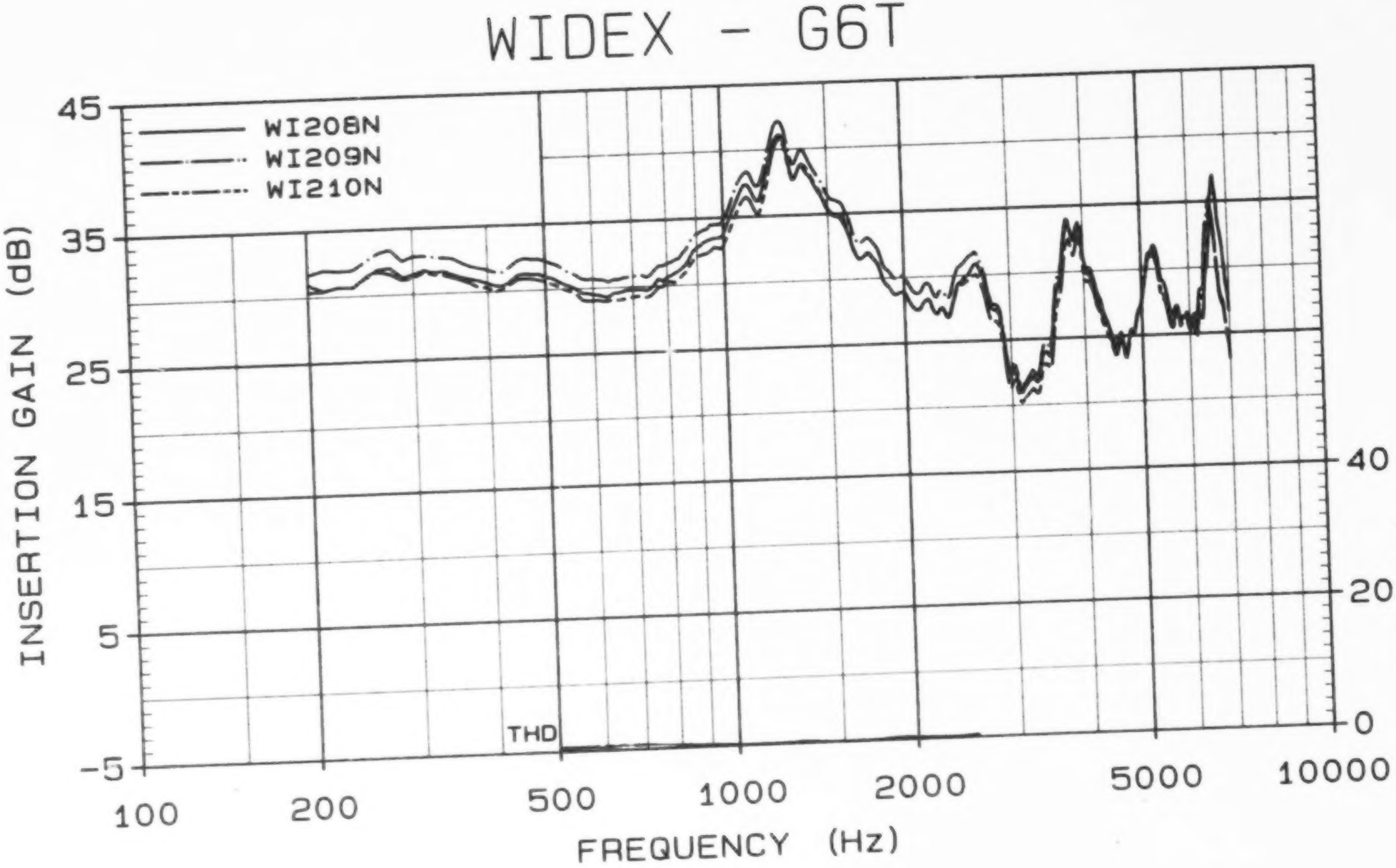
NBS CODE	WI208	WI209	WI210
SERIAL NO.	390244	389599	390064
DATE TESTED	5/11/88	5/11/88	5/11/88
DATA OBTAINED WITH VOLUME CONTROL AT MAXIMUM SETTING			
Gain at 1kHz (dB)	50	50.5	51
SSPL for shaped noise signal (dB)	117	117.5	116
with input spl (dB)	68	68	68
Induction coil output level (dB)			
Self noise	79.5	81	79.5
Vertical field= 10 mA/m	108.5	110.5	111
Lateral field= 10 mA/m	87.5	87	92
Longitud field= 10 mA/m	85.5	99	95
Calculated maximum	109	111	111.5
DATA OBTAINED WITH VOLUME CONTROL AT REFERENCE SETTING			
Gain at 1kHz (dB)	33.5	34.5	32.5
Harmonic distortion with input spl=70 (dB)			
500 Hz (%)	0	0	1
800 Hz (%)	0	0	0
1600 Hz (%)	0	0	0
Maximum distortion above 800 Hz (%)	0	1	0
Freq. of max. (Hz)	1920	2530	830
Equivalent input noise level (dB)	25	24	24.5
Battery drain (mA)			
No input signal	N.M.	N.M.	N.M.
With shaped input noise level=65dB	N.M.	N.M.	N.M.
Battery voltage (V)	1.35	1.35	1.35

Average insertion gain (dB) in 20 bands (center frequencies shown)

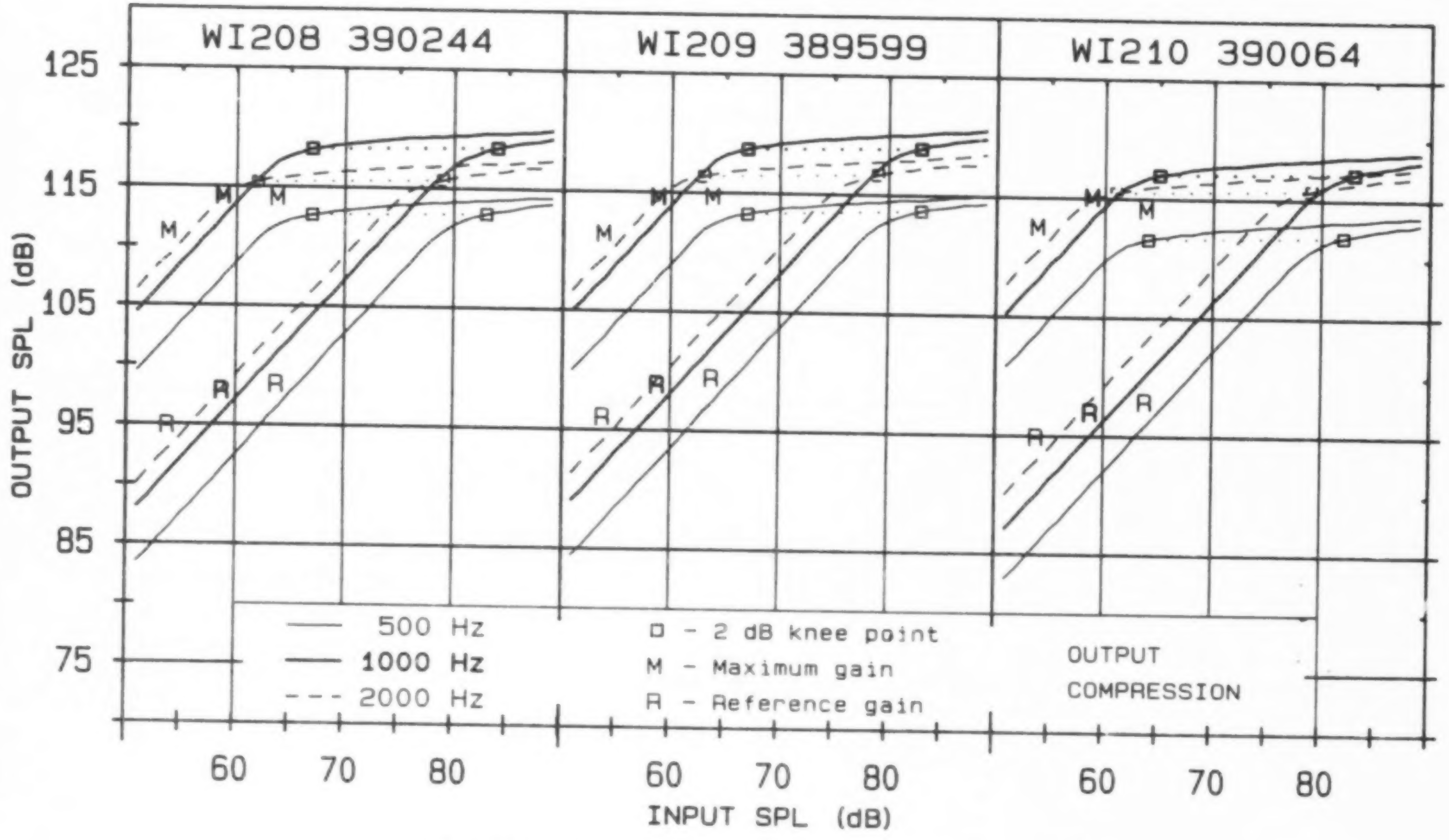
Freq (Hz)	270	380	490	630	770	920	1070	1230	1400	1570
WI208	31.5	31	31	29.5	30.5	33	36	39.5	37.5	34.5
WI209	32.5	32	32	30.5	31.5	34	37	40.5	39	35.5
WI210	31	30.5	30.5	29	30	32	35	38.5	38	34.5

Freq (Hz)	1740	1920	2130	2370	2660	3000	3400	3950	4650	5600
WI208	31.5	29	28	28	29.5	23.5	24	31.5	25.5	28.5
WI209	32.5	30.5	29	29	30.5	24	25	31.5	25.5	28
WI210	31.5	29	28	28	29	22.5	23	30.5	25.5	28

ts ts ts


WIDEX - G6T
WI208N
WI209N
WI210N
INSERTION GAIN (dB)
45
35
25
15
5
-5
THD
THD (%)
40
20
0
100
200
500
1000
2000
5000
10000
FREQUENCY (Hz)

WIDEX - G6T



OUTPUT SPL VS. INPUT SPL

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